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# THE PLAGUE INSPECTOR.

PART I.

THE PLAGUE.



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PART II.

HINTS ON VILLAGE SANITATION.

BY

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## PREFACE.

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I HAVE often been asked by Plague Inspectors and Supervisors whether there existed any book by consulting which they could refresh their memories as to the duties expected of them. Except Mr. Hankin's admirable pamphlet on "Bubonic Plague," which is addressed to the Indian public, none but references written in a style adapted solely for the medical profession has yet appeared. I have attempted to meet this demand by supplying a pamphlet as devoid of technical medical phraseology as possible.

The Plague Inspector's duties necessarily involve a knowledge of village sanitation. To have written on this subject systematically would have meant a large volume on hygiene proper. Hence, I have thought it better to ignore the theoretical aspects of the subject, and to supply extracts from papers formerly written by me concerning solely the application of practical details affecting rural water-supply, conservancy, and sewage disposal.

The Plague Inspector also should have a knowledge of how far it is possible to rely upon modern principles of hygiene being successfully amalgamated with ancient Hindu and Mahomedan tenets, which the people willingly acknowledge as correct guides. In this there should be no difficulty. Such difficulty as does exist results from ignorance amongst

the uneducated masses of the true meaning of their caste and religious laws, and from the too hasty assumption by the modern sanitarian that these conflict with the hygiene of to-day. Hence, I have added "A few notes on ancient Hindu and Mahomedan sanitary methods"—compiled from a couple of lectures given by me to public audiences sometime back.

W. G. KING.

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# THE PLAGUE INSPECTOR.

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## PART I.

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### PLAGUE.

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This disease has commonly been considered, by the uneducated classes, to be of recent origin in this country. This, however, is incorrect. It was known in India during the invasion by Tuglak (1325-1351). From 1815 to 1821, it was prevalent in certain parts of the Bombay Presidency, Scinde and Rajputana. Although it has not been recognized in the plains since this period, it has prevailed at frequent intervals in the Gharwal Hills. Sanscrit writings give a faithful description of the disease in its worst form, showing that it was recognized and studied in Ancient India. Between the thirteenth and fourteenth centuries, under the name of the "Black Death," it is reported to have claimed a quarter of the entire population of Europe. In England, it caused much mortality between 1665 and 1677. It gradually disappeared, with the advance of sanitary reform, on the Continent of Europe—but exhibited its presence in Constantinople so late as 1840. In Persia, Mesopotamia, Arabia, and Central Asia, it has ever been epidemic at intervals. Near Lake Nyanza, in Africa, it is reported to be constantly present. In certain parts of China, it has also been well known—both in ancient and modern times. In 1894,\* it prevailed in Hongkong in epidemic form. In 1896, it became

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\* A warning was issued by the Sanitary Commission for Madras in this year to all Port Medical Officers to guard against possible invasion by plague from this place.

epidemic in Bombay, having probably been imported from Hongkong. From that city, the disease has spread over a large proportion of the country.

### The Plague Microbe.

Microscopical and bacteriological study has clearly proved plague to be due to the entrance into the human being of a small rod-shaped vegetable micro-organism known as the "plague bacillus," or the bacillus of Kitasato—after the famous Japanese bacteriologist who first identified it. It is so small that it has been calculated that 500,000,000 can find accommodation upon an ordinary postage stamp. When stained by means of aniline dyes and examined under the microscope, it presents two round marks at each end of the rod, and consequently looks something like the modern rigid *pince nez*, with the connecting bar between the eyeglass frames very lightly marked on both sides. That this microbe really causes the disease has been ascertained by introducing a pure cultivation of it in susceptible animals, and also by its accidental introduction into men who have been engaged on post-mortem examinations of plague corpses, when the presence of the microbe has been verified.

### Favourable and Unfavourable Conditions for the Vitality of the Plague Microbe.

The conditions which favour the growth and reproduction of the plague microbe, bear much analogy to those governing vegetable seeds. Thus, if a cholam seed were deposited in the soil, its subsequent behaviour is found to depend upon whether the earth contains matter from which it can derive nutriment, in the form of organic and inorganic matter of correct quality; or, in other words, whether suitable manure be supplied. If this be afforded richly, the seed has much chance of reproducing abundantly, provided it be also favoured by the additional factors of heat and moisture, both of which must not be



excessive. Bacteriological experiments (by Koch, Hankin, Kitasato and others) show that the vitality of the plague microbe is discouraged and its death ultimately accomplished, by exposure to the direct rays of the sun of four hours' duration; that weak alkalies favour the growth of the microbe, whilst weak acids and oxidizing substances act inimically; that in milk it is capable of growth until acid decomposition sets in; that on earth, silk, linen, cotton, wool, and guuny cloth, the microbe dies in about six days, and on grain in a maximum of thirteen days; that in unsterilized pipe water it can exist for three days; that at the temperature of boiling water ( $212^{\circ}$ ) it perishes immediately, after fifteen minutes of continuous exposure to  $176^{\circ}$  F., and on being rendered completely dry (desiccated) by any agency. But, whilst these represent valuable leading facts gained by laboratory experiments, it does not follow that conditions found in practice need yield the same results. For example, taking the case of death of the bacillus by exposure to the direct rays of the sun, it might be assumed that the clothing of all "contacts" who had undergone a four hours' march in the sun was safe. This, however, would altogether depend upon whether the rays of the sun really had acted upon each particle of clothing contaminated with the microbe, for the full period of four hours. For example, it may well be conceived that a fold of cloth might afford protection to the living microbes against the sun's full action, or that their destruction by simple desiccation might be stayed by the existence of moisture from any source. Again, taking the opinion that on cotton and woollen clothing the microbe would die out in six days, it might be assumed that after lapse of this time the clothing of those sick of plague might well be regarded as safe. Much practical experience, however, shows, without doubt, that this is not the case. Clothing has been found capable of conveying the contagion of plague several weeks, and, perhaps, even months after the period of its infection. But, so far as is known, such instances have occurred when the clothing has been packed in

boxes or bundles, so as probably to retain a certain amount of moisture and prevent the access of the sun's rays. Similarly, sweepings of an infected house may contain plague microbes, and must be regarded as dangerous material in a road or a dust cart, because it by no means follows that though the dust *looks* dry the microbe is really desiccated, or that the action of the sun to which it has been exposed has been complete. Again, bacteriology has so far not been able to help us in proving indubitably that the soil of infected dwellings contains the microbe; yet, practical experience goes towards making this fully believed, and, at the present time, this belief is one of the chief points round which sanitary action centres itself.

Bacteriologists have proved that the plague microbe shows itself capable of undergoing modifications in virulence and in form, under varying circumstances of cultivation. Both these facts are of importance, when endeavouring to ascertain the mode of spread of plague and the varieties of the disease. Thus, experience proves that when introduced into dark, damp, and ill-ventilated dwellings having filthy soil, other conditions being favourable, the plague microbe waxes in capability of life and, probably, in virulence; for, in the organic matter found in various forms of domestic filth, it finds food, and from the unremoved subsoil, surface, or domestic waste, water, it secures the necessary moisture; whilst the absence of direct sunlight and of free interchange of air resulting from incorrect building methods place it at an advantage. If plague invades a collection of such dwellings, separated by dark, damp, and dirty lanes, it is evident favourable conditions are offered for its epidemic spread.

Under the favourable circumstances of withdrawal of moisture, and presence of great heat, such as accompany the "hot season" in India, the plague microbe certainly has diminished chances of propagation. The known influence of climatic conditions has given room for some to

assert that this or that district, or town, will not be attacked with plague. As a fact, up to date we do not know much about the subject of its preference for localities. The question of whether plague may be introduced, and, if introduced, stay, must depend upon numerous chances attending the placing of the infective matter in favourable positions, and under favourable circumstances of the nature above referred to; such a consideration must take cognizance of the full bacteriological and epidemiological peculiarities of the microbe. It would certainly appear that, in reference to introduction into a locality, the multiplication of chances has probably more to do with the matter than the one factor of climate. Thus, the direction in which plague has spread from Bombay throughout India, seems to have vast deal more to do with the amount and nature of passenger traffic than with mere climatic conditions. Indeed, plague has been found to prevail at 6,600 feet (a greater elevation than Ooty) and upon plains in a state of marsh, after inundation, and after drought and famine, and in temperatures ranging from 35 to 105 F. Under what conditions the plague microbe undergoes modification of its virulence in nature, is unknown; but, it may be assumed, from the analogy of bacteriological experiment, that this result must be connected with variations in the degree of moisture, and heat, nature of organic matter with which it is brought in contact, and rapidity with which it is transmitted to and through hosts. Thus, in Calcutta plague on its first appearance was apparently of a mild type; indeed, the existence of *pestis ambulans* (page 14) was insisted upon by Dr. Simpson, the late Health Officer of that city. After its existence in epidemic form was publicly acknowledged, it early died out; after a period of dormancy of one year, recrudescence took place. The plague microbe has, at this date, apparently increased in vigour, and is now capable of maintaining itself in the special conditions of Calcutta. In Mesopotamia, in Central Asia, and in Great Britain (1665-1674) modified and mild forms of plague were also found.



A marked peculiarity of plague is its tendency to recrudescence ; that is, to appear in epidemic form after an apparent or complete subsidence of the disease. Indeed, it may be regarded as a rule that in places where the disease has been allowed to become indigenous, recrudescence will occur. Experience shows that with the advance of very hot weather in the tropics, and very cold weather in temperate climates, a decline of prevalence of the disease may be expected ; but that in the cold climate the advance of summer, and, in the tropical climate, the addition of moisture to the moderate heat of the monsoons, are favourable to recrudescence. Such recrudescence takes place usually for two seasons, and may last for more. These facts as to appearance of the disease under modified forms, and the tendency to recrudescence during successive years, are strong arguments for prompt action with reference to all imported cases of plague in a community.

### The Animals that Suffer from Plague.

Man is not the only victim of plague ; rats and, in a less degree, mice, monkeys and cats suffer from this disease. Dr. Srinavasa Rao, Bacteriologist to the Mysore Government, has shown that squirrels and deer contract it. When the plague microbe is introduced artificially below the skin in the guinea-pig, it is readily affected ; the rabbit shows considerable resistance.

### The Incubation Period of Plague.

When the domestic hen drops eggs, a certain interval elapses when, under favourable conditions of warmth produced by her sitting upon them, chickens are hatched : this is known as "incubation." The same term is used in defining the time which intervenes between the entrance of plague germs in the human body, and the full evidence of their existence, by an exhibition of symptoms of the disease. The time that elapses varies in individuals from a few hours to ten days ; rare cases have been reported up to

fifteen days ; but the majority exhibit symptoms within the first five days after infection. This means that plague microbes, so few that they might be counted on the fingers when they originally entered the body, have been undergoing multiplication, and that their number is such, or their products have so accumulated, that the body is no longer able to maintain health in their presence.

### The Products of the Plague Microbe.

As with other microbes pathogenic (disease-bearing) to man not only is nourishment obtained during existence in the human body, but excretions are thrown off. These excretions are known as *toxins* or poisons. It is probably to the presence of these toxins that the symptoms significant of the disease are brought about, and not by the mere existence of the microbes.

### Mode of Entry of the Microbe into the System.

It is held that a frequent mode of introduction of the microbe into the human system is by trivial cuts or abrasions of the skin, by the mouth through medium of air, when lodgment may occur on an abrasion of the mucous membrane, or on the tonsils (which appear capable of ready attack), or by the lungs, and, probably, by the intestinal tracts, by medium of food and water. It is usually stated by Indian authorities that the mode of introduction into the system determines the form of plague (page 12), but the experiments of Klein on the introduction of the plague microbe below the skin of animals, do not support this opinion.

### Mode of Exit of the Microbe from the Body.

When introduced by the skin or mucous membrane of the mouth, an effort is made by the glands to arrest the microbe ; if they succeed in this, the bubonic form results. If the gland juices be examined under the microscope, plague microbes will be found in enormous numbers. On the other hand, if the glands do not succeed at first in their effort to arrest the microbe, the toxic form of plague is produced, the

intensity of symptoms apparently depending on the direct entrance of the microbe and enormous product of virulent toxins in the blood. In the bubonic form, no secretion or excretion may contain the microbe, until, on the near approach of death, there occurs failure of the glands to arrest entrance into the circulation, when all excretions into which blood can enter, such as from the mucous membrane of the mouth, nose, stomach, and intestines, or from the genito-urinary organs, may be accompanied by them; whereas, in the toxic form, exit in this manner of the microbe from the body may take place at an early stage. In the pneumonic form, the discharges from the lungs (sputa) are crowded with living microbes, and in the intestinal (Srinavasa Rau), the discharges from the bowels are similarly crowded.

The duration of the period of persistence of the microbe in persons convalescent from the disease, is still open to discussion. Taking the experiments of Kitasato—the discoverer of the plague microbe—as a guide, it is held that a convalescent cannot be considered to be reasonably safe, in reference to freedom of microbes, until the expiry of one month from subsidence of acute symptoms of the disease, or one week from the complete healing of a bubo.

It seems probable that very shortly after the commencement of the decomposition of the dead body, the microbes die; but the rapidity of their death differs with the grade of decomposition, as one authority has claimed their existence from 22 to 30 days after burial (Yokote).

### Symptoms common to the various forms of Plague.

*Attitude.*—If the case be one of *Bubonic Plague*, the patient may be found reclining, or lying down with one leg or arm placed in a flexed posture, showing a wish to relax the muscles at the armpit or groin, in consequence of either the presence, or commencing of buboes in these situations. On the other hand, it must not be forgotten that a patient may muster up sufficient strength to stand



and converse with assumed ease—although this is usually difficult on account of the tendency to faint, because of the weakened condition of the heart; or the case may be one of the “walking” form of plague (*pestis ambulans*), where the patient really feels, for the time being, little inconvenienced, and may move about, or even conduct work. In the advanced stage of the pneumonic form of the disease, the patient will usually be found lying on his back propped up in a semi-reclining position, so as to ease the breathing.

*The Expression.*—The expression of the face varies according to the stage of the disease, and the special mode in which it is affecting the patient. It is usually that of distress or dumb resignation, the latter especially being found in the “toxic” form. The lips are at times drawn tightly over the gums, so that the exposed teeth are rendered dry by the passage of air over them. When the fever is high, the features are full and soft as might be expected in a man who has just undergone rapid exertion, whilst in a most marked manner the eyes are congested; that is, blood vessels stand distinctly revealed on the surface (conjunctiva) of the eyeball. In less pronounced conditions the eye is sparkling, and has a fulness that conveys the idea of its being unusually “wide-open.”

*The Mental Condition.*—The mental condition of the patient necessarily varies with the stage of the disease, and the extent to which it has lowered the vital powers; that is, the mental faculties may be undisturbed, or be so to such an extent as to form an important characteristic of the disease. Whilst, therefore, the negative evidence would be of no value, the positive would be, in forming a diagnosis. In the less marked grade of disturbance, there is restlessness. The patient is filled with a desire to leave his bed, the house, or village. It is hence a frequent matter to find that persons in the first stage of plague have proceeded by railway or road, aimlessly. In

other instances, the attention of the patient is aroused with some difficulty, and, on a question being put, instead of a complete answer, he may proceed successfully for part of a sentence, and then either stop abruptly, or add to the end of a sensible remark words unconnected with the matter discussed. Where fever is high, delirium may set in. This is often of a severe character, the patient struggling to get out of bed, and shouting at the top of his voice. The want of reason in action and speech of the patient may lead to the impression that he is suffering from drunkenness—an impression that is heightened by the congested condition of the eyes.

*Temperature.*—When the skin is felt with the hand, it will be found dry and pungently hot. The grade of fever will be found to vary in different patients. A temperature of  $102-104^{\circ}$  is common; but it need not be hoped that the thermometer\* will do more than reveal the fact of fever existing; that is, there is no grade of temperature

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\* The Madras Government does not consider it necessary to provide Plague Inspectors with thermometers. It is, however, advisable that they should understand something of its use. The instrument is divided into a stem and a bulb. On the stem, there are figures showing the degrees. The scale shows each degree divided into fifths. The column of mercury is broken in continuity by a small space, the upper part of which is known as the index. To use the thermometer, hold it by the stem in the right hand; keep the left arm at right angles to the body; hit the left arm with the right, so as to communicate a series of jerks to the thermometer. In this way the index, if not already sufficiently low, should be made to sink till it points to  $95^{\circ}$ . Then, having dried the armpit, if moist, the bulb and part of the stem of the thermometer should be placed in the cavity of the armpit; the arm of the patient should then be folded gently across the chest, so as to retain the instrument in position. When placed in contact with a warm surface, the index will be pushed upwards by expansion of the mercury in the bulb, and when removed from the cause of warmth, the mercury will contract and leave the index behind. In reading the thermometer, the top of the index indicates the level at which the figures should be read. During health the temperature is from  $97^{\circ}5$  in the morning to  $99^{\circ}5$  in the evening: the normal average temperature is about  $98^{\circ}4$  or  $98^{\circ}6$ . The normal average temperature is signified on the scale by an arrow mark.



found in this disease that may not be present in others. Nor does it follow that a person having but a slight rise of temperature above the normal, is not suffering from plague. (See "atypical" and "apyretic" forms.)

*Respiration.*—The extent of disturbance of the system by fever will exhibit its influence by increased rapidity of respiration: but, when the lungs are affected, as in the pneumonic form, the act of respiration is also shortened and quickened.

*The Digestive System.*—The patient should be asked to protrude the tongue. This usually has a very characteristic appearance. *The Tongue (the dorsum) is covered with a white creamy coating, whilst the edges are most distinctly red.* In cases of a severe type that have already existed, sometimes the creamy covering of the tongue becomes dark, dry, and cracked in places showing the red tongue below. At the commencement of the disease, vomiting is frequent. There is usually constipation.

### Various forms of Plague.

As already stated, it is probable that the plague microbe undergoes alteration of virulence, according to the nature of the material on which it finds its nutriment, the grade of moisture and temperature to which it is exposed outside the human body, and peculiarities attending its reproduction from generation to generation. Its virulence may, therefore, differ in epidemics in different parts of the same country if much variation of climates (as in India) exists, as well as at the origin and termination of epidemics. Its influence on the human system differs, within limits, according to the mode of introduction, whilst, to some extent, the prominence or absence of certain of the symptoms vary in reference to the power of resistance of the special patient, and, probably for the same reason, according to the age of the individual and race involved. It will hence be understood that whilst there are certain symptoms—above described—which are fairly common to all forms of plague

and may be described as "common," there are others which are special to definite forms. It must be remembered that although a particular case would be classified according to the most prominent symptoms, mixed types may occur; that is, for example, there is no reason, because a patient has pneumonic plague, that he should not also exhibit buboes, although such a combination is not frequent.

The following are the forms of plague hitherto recognized:—

*Bubonic Plague.*—This is the most common form. In this, buboes appear some time between the second and fifth day of fever, in one, or more, of the following places:—

In the groin (inguinal glands).

In the upper third of the thigh (femoral glands).

In the armpit (axillary glands).

In the neck (cervical glands).

The mode of introduction of the microbe probably determines the site of the bubo; thus, if by an abrasion of the skin of the arm or hand, the bubo would appear in the armpit: if of the foot or leg, in the groin or thigh; if by the mouth, affecting the tonsils, the cervical glands would be attacked.

*Toxic Plague.*—The chief characteristic is its rapidity. As its name implies, the patient suffers from the virulence of the toxins to such an extent that excessive weakness and prostration ensue. At times, the fever is excessive; but, on the other hand, occasionally, no power to elicit reaction seems present, and temperature may not be much above 100°. Death is rapid. In the aged, sudden death occurring in the midst of an epidemic should excite suspicion of plague, a fact to which attention has been called by Captain Robertson, I.M.S. In such cases, prostration and collapse are due to the toxic form. If life is prolonged, buboes may exhibit themselves. At times, profuse bleeding from the nose and bowels may occur,

and, rarely, blood may be effused below the skin forming dark patches.

*Intestinal Plague.*—The mode of introduction is probably by food or drink that has been contaminated by the specific microbe.\* In this form there are frequent motions of the bowels, attended with vomiting and great prostration, so that a case of this description is likely to be confused with cholera. The motions, however, although light-coloured do not assume the character of “rice-water” as in that disease. Observations as to temperature are not available; it is believed that it tends not to be so high as in other forms of plague, but yet remains above normal—a matter which would help the diagnosis from cholera, where, in the arm-pit, the temperature is below normal during the stage of collapse. Buboes may, or may not, be present; at times, their appearance is delayed until the subsidence of purging.

*Convulsive Plague.*—In young children, the nervous system when subjected to the influence of the toxins of the plague microbe becomes so irritated that convulsions at times occur—followed by early death. In this case, the rise of temperature may be trivial. It is of the utmost importance not to ignore attacks by “convulsions” in children during plague epidemics, or rashly regard them as due to ordinary causes. The existence of plague amongst a family should at once be suspected, when in children convulsions and sudden death occur.

*Pneumonic Plague.*—In this case, the lungs are affected with acute inflammation. It is generally held that infection in such instances is due to entrance of the microbe into the lungs during respiration. A short hacking cough may be present, the respiration is short and hurried, the sputa may be tinged with blood, or have sufficient blood in them to give a rusty tinge. The sputa contain masses

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\* Klein states, “it follows that in a guinea pig affected with the disease [after subcutaneous injection] the bacilli pass into the inflamed intestine, and further that these can live and thrive in the small intestine.”



of microbes. As patients not in hospital are apt to spit in various places, this form of plague is therefore highly infectious, and special care to collect and disinfect all sputa is necessary.

*Puerperal Plague.*—Pregnant women attacked with plague almost invariably abort, and almost invariably die subsequently. A report of death following abortion in a community attacked, or imminently threatened, with plague, should never be carelessly dealt with; a history of possible infection should be diligently sought for.

*Apyretic Plague.*—This is a form not yet definitely recognized in India. In Mesopotamia, an epidemic prevailed in which at first fever was either not present, or very trivial, and the mortality was *nil*. As time passed, the type of disease became more severe, till all the usual forms of plague were recognized, with the accompanying mortality.

*Atypical Plague* or “walking plague” (*pestis ambulans*). This disease may be of an exceedingly mild nature, so that persons with slight fever and buboes may be so little distressed as to be capable of continuing their ordinary avocation, or travel from place to place. Such cases are probably not common; but still they exist, and are possibly more frequent than is at present known. The trivial nature of the affection dictates the necessity for the very careful examination of persons “under observation,” as cases of this description would be as likely to spread infection in a population as others. A frequent termination of the atypical form is sudden death, due to the depressing influence of the plague toxin on nerves controlling the action of the heart, if not degeneration of its muscular structure.

### Imported and Indigenous Plague.

A cholam seed cannot produce a tamarind tree, nor a tamarind tree a cholam seed; although changing organic matter in the neighbourhood of dwellings (that is, filth)

favours the growth of the plague microbe, it cannot cause it to come into existence—any more than the manure in a field would cause a crop to grow, unless seed were sown. Plague cannot exist in a locality unless it has been imported to it by a person having the microbe within him—that is suffering from the disease; or by the introduction of some articles having upon it the microbe in a living condition, that is, an article that has been contaminated by a plague subject. In consequence of these facts, it is customary and convenient to distinguish cases that are imported into a locality, and those which arise within it, as a consequence of such importation and transmission from one subject (human being or susceptible animal) to another. The former class of cases is recognized as “imported” plague, and the latter as “indigenous” plague. Whether the disease, after importation, becomes indigenous or not, necessarily depends upon whether conditions favourable for transmission and continued vitality of the microbe exist. It must here be remembered that indigenous *cases* may occur, and yet it would be erroneous to regard the *locality* as indigenously affected. Thus, on a case being imported, infection of “contacts”\* may happen. This would be an instance of simple transmission; but where the microbe is so distributed under favourable conditions as to retain vitality, and thus transmit the disease to persons other than those in direct contact with the imported case, the locality must be regarded as indigenously affected. In accepting this definition, it is also well to assume that all trace of mode of transmission of infection, as an unbroken chain, has been lost. It is convenient to adopt this view; as upon the question of whether it is possible to trace accurately the sources of infection, must largely depend the nature of the sanitary treatment that must be pursued with reference to individual localities. Thus, so long as the chain of transmission can be traced, sanitary effort can be concentrated upon houses and articles known to be infected;

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\* Persons who have been in intimate relation with a person sick of plague.

but where this evidence is lost, the more general and more haphazard method of disinfection of infected, as well as of houses not proved to be infected, is resorted to.

### Mode of Transmission of the Disease.

The conditions which are favourable and unfavourable to the growth of the microbe, its mode of entrance to and exit from the subject's body, and the species of animals liable to be attacked by it have been briefly considered. It would now be desirable to gain some idea of how transmission and spread of the disease amongst the population takes place. Perhaps, the more this can be obtained from instances in actual practice, the more correct will be the impression conveyed. At Guntakal Railway Junction, there resided a family of komatis who had relations in Hubli—distant 159 miles. Hubli was infected with indigenous plague. Business matters required the attendance of certain members of the komati family at that place. The fact of their being in charge of the railway native refreshment room at Guntakal, probably conduced to their going and coming being little noticed by officials. On their return to Guntakal Railway Junction, two male members of the family died. The family strenuously denied that the cause of death in the first case was plague ; but, on the occurrence of the second case, official suspicion was aroused, and investigation followed. Before this could be carried out, the family and the servants were scattered in the surrounding villages. Two in a dying condition were carried to the village of Timmancherla ; one was taken beyond it and died in the jungle ; a female member of the family went to the neighbouring village of Guntakal. At Guntakal, this female, who was pregnant, died of abortion. The villagers of Timmancherla were aware of the concealment of cases, but not of the danger which they incurred. With the death of the imported and concealed cases, all thought of the matter ceased in the minds of the villagers ; but, in a few days, the best educated man in the village



found rats dying in his house. After consulting a medical man, he considered it wise to vacate it, and, as a result of this prudent step, probably was saved from attack. Immediately opposite his house, there occurred the first case of indigenous plague in the person of the servant of the komati family; further cases then followed, not be it remembered in scattered parts of the village, but within a small and readily defined area round the now vacated house, where these dead rats were found. In the case of this village, the Brahmin Tahsildar, using the Shashtra which is quoted in Part II. (page 158) as his authority, induced the villagers, after a long oration, to promptly vacate the infected area, and ultimately the whole village. Each villager promised, and probably actually did, boil all clothing, and exposed to the sun for eight hours all other articles taken to the camp, and destroyed all soiled mats and worthless articles by fire, before departure from the village. After departure to camp not a single case of plague occurred. This complete immunity was of course a coincidence, as it is evident that no person happened to be undergoing incubation at the time of departure. The result in this instance, however, contrasts strongly with events at Guntakal village. Here it will be remembered one member of the family had suffered from what was reported to be simple abortion, but which was really the puerperal form of plague. Hence attention to the matter was delayed some days. Disinfection, however, of this house ultimately took place; but no segregation of contacts was arranged for. Three weeks subsequently, the first case of plague occurred in the immediately adjoining house. Thence, the disease spread amongst the Hindus. These, after some delay, evacuated their homes, and erected temporary dwellings in the neighbouring fields. The Mahomedans, however, in ignorance of the true tenets of their religion (page 163), neglected the advice as to evacuation, and suffered in proportion to their numbers to a very great extent, until, compelled by the fear of extinction, they proceeded to evacuate their houses. The

disease then shortly ceased. The village of Timmancherla is within  $1\frac{1}{2}$  miles of the village of Guntakal; the conditions of buildings, the sanitary habits of the people, and the nature of soil, are practically identical. In the village of Timmancherla (population 1,206) vacated, after a short hesitation, the percentage of attacks was 0·8, and in Guntakal (population 4,797), where complete evacuation was prolonged, it was 2·7. It may be added that there is reason to believe that the original komati family that imported the disease had regular business dealings with two other families of this caste, that started the disease in the neighbouring villages of Molagavalli and Chippagiri; this business entailed their visiting the houses at Guntakal Railway Junction in which the first case occurred, but whether they actually did so during the period of sickness of the first cases has not been proved.

The above examples show that after introduction (*e.g.*, the “puerperal” case at Guntakal village) by an imported case, infective matter may retain its vitality, and not have an opportunity of entering a human being for the lapse of a fortnight or more, during which sanitary activity of the authorities is liable to be lulled; that, on its first attacking the inhabitants of an area into which it has been freshly imported, there is very marked tendency for it to maintain its influence within narrow limits; that its subsequent general spread amongst the population—granting the conditions are favourable for retention of vitality of the microbe—is a matter of time and of opportunities afforded for infection, which must, again, naturally depend upon nature of occupations influencing the amount of intercommunication of persons, interchange of articles liable to retain infection, the possible distribution of the microbe by flies and ants after contact with infective matter, and fleas and bugs as blood-sucking insects, and spread of the epidemic to certain lower animals—especially rats; but that prompt evacuation of houses is the most effectual remedy against the spread of the disease, and should be employed without delay



when it is no longer possible to precisely define the limits of infection, as can be done when dealing with an imported case.

### Organization for prevention of spread of plague.

If we believe that plague cannot be created from filth, but can only find in filth a congenial home, that is to say, that a plague case must derive its source of infection directly or indirectly from a previous case—just as in cholera, small-pox, typhoid, etc.—it would at once strike us that the easiest and most efficient way to prevent a country being attacked, would be to absolutely prevent all intercourse with places that are known to be infected. It would be necessary that all importation of goods and of persons should cease; that is, trade and passenger traffic must be stopped absolutely. Treated under such a system, undoubtedly, countries could prevent entrance of plague for an indefinite period. In practice, however, this exclusion of a people from communication with the outer world can rarely be adopted; for, whether the community that makes the attempt be situated in the centre of Africa or close to the North Pole, there must at length arise a period when, for the sake of some article of commerce necessary for nutrition, or the prosecution of manufactures, strict exclusion can no longer be maintained. It might be possible for a small community, say, resident upon an island, to practice this method for a short period; but, it would be absolutely out of the question for any great country to attempt it. It might be thought, however, that it would be at least feasible to separate one part of a country known to be suffering from the disease from that still free from it, so as to secure the desired exclusion. This is also impossible; as shown by the complete failure of extensive trials of this mode. Russia has tried to prevent the spread of plague in this manner by arranging a line of troops (cordon) through extensive areas of country, with implicit orders to stop the passage of unauthorized persons. Nevertheless, persons undergoing incubation of plague have successfully passed through the cordon, and given rise to epidemics costing

many thousands of lives. In such matters, the persons who should be kept out realize that "where there is a will there is a way."

The impracticability of enforcing such methods of absolute exclusion has led to the attempting of quarantine. Under this system, neither sick nor healthy are allowed to land within the country demanding this precaution, until, in the case of the former, a period after convalescence has been undergone and, in the case of the latter, complete freedom from sickness has shown that the person has not been infected. Under this mode, it was not infrequent to require thirty or forty days quarantine before admission. It need not be said that this type of sanitary legislation involved much inconvenience upon individuals, and loss to trade. Quarantine has long found support from Continental nations in Europe; but England, under the advice of successive Medical Officers of the Local Government Board, set her face against it, and after much international discussion (first as to cholera and latterly as to plague) the wisdom of resorting to a system of "observation" has been established. In the first two years of plague administration in Bombay, "land quarantine" was illustrated by the use of "camps of detention." All persons arriving at certain points by rail were taken out of the trains, and whether healthy or sick, were made to remain there for a period of ten days after undergoing disinfection of their clothing. In this Presidency, on the opposite, before the Government of India had by its Epidemic Disease Act shown the direction it would require the local Governments to follow, and before the Venice Convention had shown that the principle would be accepted throughout Europe, the Madras Government decided upon, and put into operation, a system of "observation", or, as it is elsewhere called, "surveillance," both by sea and land.

The principle of "observation" is very simple; it involves a knowledge of the duration of incubation of the disease to be resisted, and application of methods that shall ensure

that persons possibly passing through this stage shall be maintained under surveillance, until the lapse of the calculated number of days shall show that they are not infected persons, and, therefore, liable to transfer infection to others; secondly, application of methods that shall secure the rapid separation of the sick from the healthy, and the isolation and destruction of all infective matter.

### The regulation of passenger traffic by land from infected areas.

The maintenance of surveillance can be managed by means of passports, provided the people dealt with have a moderate degree of education, and that suitable staffs be provided. It would be requisite to arrange that these passports be issued at the first point of arrival from infected areas. The points that have been selected for this purpose are Ports, Railway Stations, and Frontier Roads. At each of these places the state of the traveller is examined, and if there be no reason to suspect he is suffering from plague, as disclosed by the presence of fever, or other suspicious symptoms, and if he be able to give an address that can be depended upon, he is allowed to proceed on his journey, after signing the "passport," which binds him, under penalty of prosecution, to present himself for examination for a period of ten days, and to notify each change of address until the expiry of that period. The method saves the inconvenience to the traveller of being detained so long as not exhibiting signs of ill-health, whilst retaining such power as will permit of his being rapidly isolated, should symptoms of the disease present themselves.

It must however be recognized that amongst the ignorant there will constantly occur instances where no address can be given, and others that are of so low a class it would be impossible to trust their statements; again, there are persons whose clothing and bodies are so foul that, with the knowledge that they have been within infected areas, it would be impossible with reason to place them



under a system that practically leaves them free agents. Hence, at the discretion of the officers specially appointed by Collector for this purpose—usually officers in charge of frontier road and railway stations—persons of the character mentioned may be detained under observation in a suitable camp, until the expiry of ten days, instead of allowing them to depart with passports.

The passport form sanctioned in the Madras Presidency is appended. As it contains full directions as to what is to be done, it is not necessary to repeat these requirements.

The following Officers are authorized to issue passports :—

- |   |  |
|---|--|
| (a) To travellers alighting at Railway inspection stations.                       | { The Medical Officer in charge or other officer acting under his orders.  |
| (b) To travellers alighting at Railway stations included within Municipal limits. | { Such Medical, Sanitary or other Officer as may be appointed by the Chairman with the Collector's approval.   |
| (c) To travellers alighting at other Railway stations.                            | { The Stationmaster or other Officer appointed by the Collector for the purpose.   |
| (d) To travellers arriving by steamer, ship or boat.                              | { The Medical, Sanitary or other Officer appointed to examine such travellers.   |
| (e) To travellers arriving by road.   | { The Medical, Sanitary or other officer appointed to examine such travellers, or, if no such officer has been appointed, the local authority of the place of arrival. |

It will be observed that no mention is made here of Sanitary Inspectors. These, nevertheless, may be given authority to issue passports, and would be included under the term "other officer" appointed by, or with the approval of, Collectors.

But having been provided with passports, notwithstanding the possibility of prosecution hanging over them in case of failure, it does not follow that passengers are sufficiently thankful to escape a system of quarantine to show it practically, by exhibiting themselves for a period of ten days to local authorities without supervision. Hence, it is necessary to evolve a method that shall ensure that

A.

B.

C.

Passport No.

Original.

Passport No.

Duplicate.

(To be retained by the officer  
issuing the passport.)

(To be issued to a person arriving from a plague-  
infected locality, or any notified area, under  
Regulation 22 under the Epidemic Diseases Act  
published in the "Port St. George Gazette," Part  
I-A, dated April 11, 1899, page 137.

(To be sent forthwith to the officer appointed to conduct the ten  
days' inspection.)

1. No. of passport.

1. District.

1. District.

2. Date of issue.

2. Station of issue.

2. Station of issue.

3. Name of traveller.

3. Date of arrival.

3. Date of arrival.

4. Place of destination.

4. Name of person.

4. Name of person.

5. When the duplicate of the  
passport sent and to whom.

5. Father's name.

5. Father's name.

6. Caste.

6. Caste.

7. Age.

7. Age.

8. Whence coming.

8. Whence coming.

9. Destination and residence during the next ten days  
(give District, Taluk, Village, Street and Number  
or Name of the owner of the house).

9. Destination and residence during the next ten days (give  
District, Taluk, Village, Street and Number or Name of the  
owner of the house).

I declare the above information to be correct, and  
to appear  
I do hereby bind myself \_\_\_\_\_  
to present the abovementioned  
person for inspection, daily, for a period of ten days  
from this

I declare the above information to be correct, and I do hereby  
to appear  
bind myself \_\_\_\_\_  
to present the abovementioned person  
daily, for a period of ten days from this date before \_\_\_\_\_

Initials of officer issuing  
passport.

Date

Signature or mark of traveller.

Date

Signature or mark of traveller.

Declared and signed before me.

Declared and signed before me.

Signature and designation of the officer  
issuing the passport.

Date

Signature and designation of officer  
issuing the passport.

Date

(See reverse.)

(See reverse.)

C.

Instructions to the officer appointed to conduct the ten days' inspection.

1. The officer shall daily inspect the passenger and initial the original passport in token of the inspection.

2. He shall daily ascertain from the passenger whether there is any sickness or death in the house in which he is or has been residing. If the passenger is found to exhibit any symptoms of plague, or if any sickness or death is reported in his house, or if the passenger does not appear for examination on any day, the fact should be immediately reported to the President or the Health Officer of the Municipality.

3. If the passenger intimates or it is otherwise known that he desires to leave Madras within the period of ten days, the particulars of his future residence should be obtained and the fact communicated without delay to the local authority of the place of the new residence. The officer before whom the passenger must present himself for inspection at the new place of residence should be entered in the passport. Intimation of departure to any Railway Station in the province of Mysore should be telegraphed to the—

(a) Assistant Surgeon on plague duty, Yesvantpur, when the destination is a station on the Mysore State Railway;

(b) Residency Surgeon, Bangalore, when the destination is a station within Mysore Province on the Madras Railway

4. The inspecting officer should maintain a register in the following form:—

- (1) Date of receipt of intimation.
- (2) Name of traveller.
- (3) From what infected area arriving.
- (4) Date of arrival of traveller.
- (5) Number, date and place of issue of passport.
- (6) How long kept under observation.
- (7) State of health of the traveller and other persons living in the house in which he is or has been residing.
- (8) Date of departure if occurring within ten days.
- (9) Destination.
- (10) Date of intimation of departure to the local authority of the place of destination.
- (11) Date of despatch of the passport to the President, Municipal Commission, Madras.

B.

Endorsement of the Inspecting Officer.

Date	Signature	Designation
1st day		
2nd "		
3rd "		
4th "		
5th "		
6th "		
7th "		
8th "		
9th "		
10th "		
Forwarded to the President, Municipal Commission, Madras, the passenger having been duly inspected.		
Date	Signature and Designation of the	Examining officer.

Regulation 22 under the Epidemic Diseases Act, published in the "Fort St. George Gazette," Part I-A, dated April 11, 1899, page 137.

*City Regulation 22.*—Every person arriving, or suspected of having arrived, from any place declared to be infected with plague, or from any place notified by His Excellency the Governor of Fort St. George in Council for the purposes of this regulation, shall, unless exempted under Regulation 21, be bound to appear at a place provided for the purpose and obtain a passport binding him to present himself daily for inspection for a period of ten days before the officer named in the passport, and he shall be bound so to present himself. On the expiry of ten days, the passport-holder shall deliver up his passport to the inspecting officer for transmission to the President, Municipal Commission, Madras. In case he has to leave Madras City within ten days from the date of his arrival, he shall forthwith give intimation to the inspecting officer, who shall report the fact to the local authority\* of the new place of residence, and enter in the passport the name of the officer before whom the passenger must present himself at the new place of residence, and the passenger shall be bound to present himself accordingly.

Provided that, when it appears desirable, the President, Municipal Commission, Madras, or the Health Officer may, by endorsement on the passport, exempt any person from personal attendance and permit him to be inspected at his residence.

In the case of minors and incapacitated persons, the obligation to take out passports for them, to present them for daily inspection, to report truly their names and addresses, to intimate any changes in their residence, and to comply otherwise with the requirements of this regulation shall vest in their legal guardians or persons in whose charge they travel or who receive them at the railway station of destination.

*N.B.*—Any person disobeying or evading the above or any other Plague Regulation or any order made in pursuance thereof renders himself liable to prosecution for an offence punishable under section 188 of the Indian Penal Code with imprisonment of either description for a term which may extend to six months or fine which may extend to Rs.1,000 or both.

\* *Vide* Mutassal Regulation 17 (i), published in the *Fort St. George Gazette*, dated April 11, 1899, Part I-A, page 139.

A.

the necessary discipline is attained, in the case of those who have been given passports at the frontier, and to secure that these shall be issued to persons who may have evaded the frontier stations, and have entered the unaffected area. In the Municipal towns, this is possible by increasing the existing Municipal sanitary staff; to effect supervision in rural areas, there are ready the staffs of Unions and, in the smaller villages, there are the Village Heads—long drilled to obedience by Revenue officers. In rural areas, it is obvious that the greatest likelihood would exist of a breakdown of the system, as it would be impossible to detach Revenue officers in sufficient numbers, without undue interference with their current duties. Hence, has arisen the necessity for creating “circles,” of a size that it may reasonably be hoped can be kept under efficient supervision. These “observation circles” are ten miles in diameter, and are each in charge of a Sanitary Inspector—as persons best fitted for effecting duties chiefly of a sanitary nature. Over each four circles—forming a “division”—are appointed Plague Supervisors, who superintend the labours of the Sanitary Inspectors of observation circles, and are responsible to the Collector, through the District Sanitary Officer, that their work is correctly performed. Plague Supervisors are usually of the European or Eurasian class, and are selected with reference to former training in other departments fitting them to maintain discipline.

In employing a staff to supervise surveillance of passengers, it is evident that if possessed of a sanitary training, it could also be required to suggest and supervise sanitary details for improvement of localities, so as to better prepare them for resisting plague, and, when invasion has actually taken place, to combat it. This implies the presence not only of the supervising executive staff (Sanitary Inspectors), but also of an efficient menial agency including scavengers and sweepers, provided with the necessary plant. The expense involved in a complete scheme of this



nature could not be met under the present rulings as to distribution of the finances of Local Bodies. Hence, whilst the influence of the Village Heads, acting in conjunction with the Sanitary Inspector, is trusted to for improving the details of the sanitary state of villages before invasion (*plus* improvements by routine minor sanitary engineering works in localities specially requiring aid of this nature) actual attack of a locality is met by the bringing from a central point in each district an ambulance staff, capable of affording sanitary, medical, and menial aid, so as to fill the want of permanent staffs in the areas concerned. As soon as an ambulance staff has been despatched to a locality, another is at once engaged to take its place in reserve. The composition of an ambulance staff is as follows:—

- 1 Certificated Sanitary Inspector.
- 2 Trained European or Eurasian Nurses.
- 4 Male ward attendants.
- 3 Female ward attendants.
- 4 Dhooly bearers.
- 3 Male and 2 female toties.
- 2 Dhobies.
- 2 Cooks.
- 2 Hospital Assistants.
- 1 Compounder.

75 to 100 men of the Madras Infantry, with tent equipage, under command of an European Officer, are attached. Failing these men, coolies in sufficient number are recruited. For these, 50 pairs of shoes are carried with the ambulance equipment.

This staff carries everything for the furnishing of a temporary hospital, as well as the sanitary equipment for disinfection of indigenously affected areas. The nature of the latter will be found at page 81.

It must be remembered that the staff simply represents first aid sent to a spot. Its numbers and equipment can be strengthened as subsequently found necessary.



A further method of strengthening the sanitary supervision is employed during invasion of a locality, by making the diameter of observation circles five instead of ten miles, in the neighbourhood of infected areas, for a radius of twenty miles. These are known as "preventive circles" (Plague Commissioner's Proceedings, No. 88, dated 7th Oct., 1898). When the area of the charge is thus contracted, necessarily the Sanitary Inspector should be capable of more frequently visiting each village in his care, and thus be in a better position to quickly detect suspicious plague cases.

In Municipalities, the mode adopted is the same in principle as for rural areas, but differs in detail (*vide* G.O., No. 522 M, of 13th March, 1897, quoted at page 61 of the Madras Plague Regulations and Rules). Without interfering with the existing Municipal sanitary staff, it is strengthened by additions. Thus, the Municipality is mapped into Circles, which must not include in each more than 10,000 inhabitants. Three such "Observation Circles" make a Division. To each Circle are added one Inspector, one peon, one toty. To each Division is appointed a Divisional Sanitary Inspector, with a mounted orderly. This is known as the Observation Staff, and is employed directly invasion is feared. On a single case of plague occurring in a Circle, three peons and three toties are added to the Observation Staff, which is now known as the "Preventive Staff." The complete staff must be maintained in a "Preventive Circle" for ten days after the last attack of plague in it, and the Observation Staff in all circles for twenty-one days after the last attack in the town. It must be remembered that the numbers of staff laid down simply represent the minimum requirement that should be instantly available. They would be added to promptly during an epidemic, irrespective of the ambulance staff, which would join for duty directly indigenous plague declared itself.

So long as "observation duty" is demanded, the extra staff is at the disposal of the Chairman; as soon as it is

converted to a "Preventive Staff," on the occurrence of plague, it is administered by the District Medical and Sanitary Officer, unless a Plague Officer be appointed.

So far the organization detailed has dealt with the executive sanitary supervising and menial staff; but it is evident that a further increase would be necessary of administrative staff to control them. This is effected by enrolling officers of the Staff Corps as Plague Officers, in addition to officers of the Indian Civil Service, and Additional Medical Officers imported from Great Britain, as a reserve for the Indian Medical Service. According to Regulation No. 26, the following is the classification of the additional Officers :—

"(a) A Superior Staff consisting of Plague Officers appointed by Government.

"(b) A Subordinate Staff consisting of Assistant Plague Officers appointed by the Collector.

"(a) Plague Officers include Divisional-officers, Assistant Collectors and the District Medical and Sanitary Officer, and also Personal Assistants to the Collector ;

" Special Divisional-officers (either to relieve Divisional-officers engaged in plague operations or to be in plague charge of a division) ;

" Extra Assistants to be in charge generally of a Taluk but, if necessary, of a smaller area.

"(b) Assistant Plague Officers shall be Tahsildars and Deputy Tahsildars (ordinary or special) *ex-officio* ; or persons of known and approved character and responsible position, specially appointed.

" Assistant Plague Officers shall have the powers given by Regulations 3 and 7 and (in infected areas) 27 of the Regulations published in *Fort St. George Gazette* Notification No. 897 of 18th December 1897. Plague Officers shall have these powers, and shall also have powers given by Regulations 4 and 5 and (in areas Under Observation) 27."

The whole details of administration of plague involve much responsibility in giving orders to Collectors in charge of Districts, and as to expenditure of public money. Hence, immediately subject to Government, it has been found necessary to appoint a special Civil Officer with an office establishment. He is known as the Plague Commissioner.

### Vigilance Committees.

In all civilized countries, there are to be found public-spirited citizens who, in the midst of any calamity affecting their countrymen, will volunteer to give aid to special organizations appointed by Government, without expecting salaries in return. Where infectious diseases have to be contended with, it is customary for the inhabitants in parts of Europe and America to form themselves into what are known as "Vigilance Committees." Thus, it being recognized that neglect of cases of imported plague must lead to its disastrous propagation in its indigenons form, such persons find a most important duty in aiding the official methods of ascertaining the whereabouts of suspicious cases. Of those who volunteer for this duty, men of position and influence should be selected. In villages it would suffice to have a single committee; but in towns of over 10,000 inhabitants, one should be organized for each division—using that term in the meaning implied at page 25, in reference to arrangements in Municipal towns. Each member should have charge of an area including not more than 200 houses. The selected candidate should have an intimate knowledge of the people whose interest he wishes to serve, and should not be distasteful to the inhabitants of the area in charge. For example, it would, as a rule, be a hopeless matter to employ for charge of a Brahmin-inhabited area a Mahomedan. The Chairman of the Vigilance Committee should be generally recognized as possessing influence for good amongst the people, and should not be an official, except in villages, where the Village Head would be useful.



Each member of the Committee should daily perambulate the area assigned to him, and should, by enquiry from house to house, ascertain what new arrivals have been made, what cases of sickness exist, what urgent sanitary errors demand correction. In moving amongst the people, they should endeavour to impress upon them the advantages of inoculation as a protective against plague (page 98) and the risk of spread of plague following concealment of cases. They should also explain the benevolent intentions of Government in attempting to repress plague, and do their best to get rid of the many stupid misapprehensions of the uneducated classes on this subject.

It is common for native gentlemen to allow their names to appear as members of a Vigilance Committee, and yet do nothing *practically* to justify their nomination. It should, therefore, be understood that any member who fails to inspect his area any three days in succession should be struck off the list. To secure systematic work, it is well that small report cards should be filled up daily by each member, and sent to the officer responsible for plague administration in the village or town concerned. This may seem a waste of stationery; but experience shows that, if utility is to be fulfilled, some mode of record of work done is essential. The following form, in the vernacular, should suffice :—

Between the hours of \_\_\_\_\_ and \_\_\_\_\_ I made enquiries in the following streets \_\_\_\_\_ I found \_\_\_\_\_ suspicious case at \_\_\_\_\_ The following persons have arrived at the addresses opposite their names from infected areas :—

The following deaths were ascertained :—

Not only should the members of the Vigilance Committee prove useful by making inspections, but also by making suggestions of a character that will meet caste and race prejudices, to those in charge of plague administration locally. Thus, it frequently happens that the ignorant of a community who unite to obstruct plague



officials mischievously declare such and such a measure contrary to caste, religion, or custom—knowing that as to the first two at least every respect will be given. But enquiry by men of the philanthropic type that should be selected for a Vigilance Committee will often demonstrate that the people who make truculent claims on behalf of caste or religion, are absolutely ignorant of the true tenets of either, and are merely supporting some popular, yet absolutely erroneous, interpretation. A member of a Vigilance Committee who can make the people, on the one hand, correctly understand their caste or religious laws and, on the other, guide officials as to their true interpretations, cannot fail to be both of use to the Government and his countrymen.

### The Regulation of Passenger Traffic by Sea from infected Areas.

It follows that any method of watching arrivals by rail or road from an infected area or country, must be supplemented by one devised for inspection of passengers by ships. The principles involved are, that the ship shall never be detained longer than necessary to ensure disinfection, and that, whilst the sick are segregated, the healthy are permitted to depart to their destinations under the “passport” system. At page 46 of the Madras Plague Regulation and Rules, will be found the orders regulating the conduct of sea traffic. The Sanitary Inspector is not likely, in this connection, to be called upon to perform other duty than that of superintending disinfection processes and removal of sick; but it is desirable he should understand the principles on which the Regulations are founded. These are given in the following extract from the Venice Convention :—

#### SECTION VIII.

“ Any ship with plague on board, or on board which one or more cases have taken place within 12 days will be considered infected.

Any ship on board which there has been a case of plague at the time of departure, or during the voyage, but on which no fresh case has occurred for twelve days will be considered as suspected.

Any ship even though coming from an infected port, which has had no death, or case of plague on board, either before departure, during the voyage, or on arrival, will be considered as healthy.

Infected ships are subject to the following rules:—

- (1) The sick will be immediately disembarked and isolated.
- (2) The other persons on board should also, if possible, be disembarked and kept under observation or surveillance for a period varying according to the sanitary condition of the ship, and the date of the last case, but which may not exceed ten days.
- (3) The soiled linen and personal effects of the crew and passengers which in the opinion of the sanitary authority of the port, may be considered as infected will be disinfected.
- (4) The bilge-water will be pumped out after disinfection, and good drinking water will be substituted for the water stored on the board.
- (5) All parts of the ship which have been inhabited by plague patients should be disinfected. More thorough disinfection may be ordered by the local sanitary authority.

Suspected ships are subject to the following measures:—

- (1) Medical inspection.
- (2) Disinfection ; the soiled linen and personal effects of the crew and passengers which in the opinion of the local sanitary authority may be regarded as contaminated should be disinfected.
- (3) Pumping out the bilge-water after disinfection, and substitution of good drinking water for the water stored on board.

- (4) Disinfection of all parts of the ship which have been inhabited by plague patients. More thorough disinfection may be ordered by the sanitary authority.

It is recommended that a watch should be kept over the health of the crew and passengers for ten days from date of arrival of the ship. It is also recommended that the crew should not be allowed to land, except on duty.

Healthy ships will be given free pratique at once, irrespective of the nature of the bill of health.

The only measures which the authorities of the port of arrival may enforce with regard to such ships consist in those which are prescribed in the case of suspected ships (medical inspection, disinfection, pumping out the bilgewater, and the substitution of good drinking water for the water stored on board), except that the measures prescribed for the disinfection of the ship itself may not be enforced in the case of health ships.

It is recommended that the crew and passengers should be kept under medical supervision for ten days from the date on which the ship left an infected port.

It is also recommended that the crew should not be allowed to land except on duty.

It is to be understood that the appointed authority of the port of arrival may always demand a declaration on oath, from the doctor of the ship or failing him from the Captain that there has been no case of plague on the ship since her departure.

In deciding on the extent to which effect is to be given to the measures prescribed above, the authorities of the port should take into consideration the fact that there is a doctor or a disinfecting apparatus (stove) on board the ships coming under the three headings mentioned above.

Special measures may be prescribed for crowded ships, particularly for emigrant ships or any other ship which appears to be in an insanitary state.



Goods arriving by sea should be treated in the same way as goods arriving by land, as regards disinfection, prohibition of import, transit and quarantine.

Any ship objecting to the obligations imposed by the authority of the port will be free to put back to sea.

The disembarkation of goods may be authorized, after the following necessary precautions have been taken :—

- (1) Isolation of the ship, crew and passengers.
- (2) Pumping out the bilge-water after disinfection.
- (3) Substitution of drinking good water for the water stored on board.

The disembarkation of passengers wishing to land may also be authorized, on condition that they submit to the measures prescribed by the local authorities.

Each country should supply at least one port on each of its boards with the organization and equipment necessary to enable it to receive a ship whatever its sanitary state.

Coasting vessels will be subject to special rules, to be drawn up conjointly by the counties concerned."

### Regulation of Importation of Articles from Infected Areas or Countries.

It has been granted that not only is infection carried by persons but also by articles. To demand that importation of articles from infected countries should cease, although passengers be allowed entrance under observation, would be beset with exactly the same difficulties that surround complete exclusion already discussed. It would but result in articles required being smuggled into a country, in spite of vigilance. Hence, it has been found wiser to class articles into those which are "susceptible," and those which may be regarded as not specially "susceptible."

Here is an extract from the Venice Convention, showing the nature of the international agreement as to importation from an infected country :—



## (I). IMPORT AND TRANSIT.

The following is a list of the susceptible articles and goods, the importation of which may be prohibited :—

“ (1) Used linen clothing, personal effects and bedding.

“ When these articles are carried as baggage, or in consequence of a change of abode (household goods) they are subjected to special treatment.

“ Soldiers’ and sailors’ kits returned to their country, after their death, should be treated in the same way as the articles named above.

“ (2) Rags, not excepting rags compressed by hydraulic force which are carried as merchandise in bales.

“ (3) Old sacking, carpets and old embroidery.

“ (4) Raw hides, untanned and fresh skins.

“ (5) Animals’ refuse, claws, hoofs, horse hair, hair of animals generally, raw silk and wool.

“ (6) Human hair.

“ The transit of susceptible goods or articles packed in such a way that they cannot be handed on the way should not be forbidden.

“ Similarly, when merchandize or susceptible articles are transported in such a manner that cannot have come into contact with infected objects during the journey, their transit through an infected local area should not bar their importation into the country to which they are consigned.

“ The rules regarding the prohibition of the import of susceptible goods and articles will not be applied in cases where it is proved to the satisfaction of the appointed authority of the country to which they are consigned that they were despatched at least five days before the occurrence of the first case of plague.

“ Merchandise must not be kept in quarantine on land frontiers.

“ Absolute prohibition or disinfection are the only measures which may be taken.

## (II). DISINFECTION.

“*Baggage*.—Disinfection will be compulsory in the case of soiled linen, wearing apparel, clothes and articles carried as personal baggage, or household goods, coming from a local area, declared infected, and which the local sanitary authority deems contaminated.

“*Merchandise*.—Disinfection will only be enforced in the case of merchandise and articles which the local sanitary authority considers contaminated, or whose importation may be prohibited.

“It rests with the authorities of the country to which the articles are consigned to settle the manner by which any place in which disinfection should be carried out.

“The disinfection should be carried out so as to injure the articles as little as possible.

“Each country will settle the question of the compensation to be paid for damages resulting from disinfection.

“Letters and correspondence, printed matter, books, newspapers, business documents (not including parcels received through the post) should be subject to no restriction or disinfection.”

The above will afford an idea of the principles which guide action as to possibly infected articles. The full value to the word “may” must be given to the phrase “may be prohibited.” The discretion rests with the Government of the receiving area. Thus, at the present moment, the only articles whose importation from infected areas is prohibited in this Presidency are apparel that has been worn, used bedding, rags, and waste paper. In the case of importation from Mysore also, the destruction of the litter and waste surrounding vegetables, and of once used poultry baskets is provided for. The importation of second-hand gunny bags was for some time forbidden, but this is no longer in force.

## Duties of a Sanitary Inspector in charge of a Rural "Observation Circle."

It is now necessary to see what part the Sanitary Inspector plays, in the scheme above described for effecting observation of immigrants from infected areas. It may happen, when first appointed, the Sanitary Inspector will be beset by suspicion of his objects, and by constant questionings throwing doubt on the good faith of the Sircar. He should answer such questions with the utmost patience and consideration. His business is not to "bahadur" about a village, insisting upon this and that being done, in a voice replete with the importance of temporary authority, but to enter into friendly converse with the people, and explain to them in what manner Government is striving to attain their protection from disaster. One of the most serious faults a man in this position can make, is to tell the people falsehoods. It is a curious trait, in some persons, that rather than take the trouble to explain patiently to a rough villager the real truth, they will construct on the spot some "cock and bull story" that, in the long run, will do infinite harm. This is done under the belief that the truth is too difficult to be grasped by the hearer; yet, the villager has not been found who cannot understand sanitary procedures, even if he does not appreciate them, on receiving a simple and truthful explanation. For example, a matter that frequently gives rise to trouble is the villager not understanding legal rulings and apparent vagaries of the disease, that are the outcome of the period of incubation. Especially, he fails to understand why a person who is inoculated should, within ten days of this protective operation, be liable to attacks of plague; yet, if the Sanitary Inspector will state in simple language what is meant by incubation—a matter that can be readily understood by an agriculturist accustomed to watch the germination of seed, and the incubation of eggs—the whole subject becomes perfectly clear, and misinterpretation of the acts and policy of Government officials disappears.



The following extract from the Additional Regulations states, in concise terms, the nature of the appointment, and what is expected, of the Sanitary Inspector, or, as he is there officially known, the "Plague Inspector" :—

"6. For the taluks necessary in his opinion to be watched, the Collector may appoint the requisite number of Plague Inspectors, who should be given a range with a radius not usually exceeding five miles. For non-municipal towns, [of 10,000 or more inhabitants] Assistant Plague Inspectors may be appointed.

The Collector may also appoint Plague Supervisors to check the work of Inspectors and Assistant Inspectors, who shall report through them to the District Sanitary Officer.

"7. This observation staff shall work under the District Medical and Sanitary Officer in subordination to the Collector. Its duty will be to constantly and systematically patrol the circles in order to gain the earliest possible information of a case of plague, so that immediate action may be taken, and to report any pressing sanitary need to the District Medical and Sanitary Officer. It should also check the possession of passports or passes in the case of persons arriving from an infected locality. Should any person so arrive without a passport or pass, or having broken its conditions, any member of the observation staff may detain him and cause him to be produced before a Plague Authority who may subject him to isolation in the nearest proper place.

"Inspectors and Assistant Inspectors shall keep a record of all persons suffering from continuous fever for more than twelve hours and shall arrange with the Village Headman to have such persons inspected twice daily. If a member of the observation staff shall discover a case of plague he shall act as laid down in Regulation 17."

In each District, the District Medical and Sanitary Officer will doubtless lay down specific rules as to the exact manner in which it is expected the Sanitary Inspector should fulfil his duty, but, whatever the details, the same



principles are involved. It may, therefore, be said that it is the duty of the Sanitary Inspector to go from village to village in his circle, *so that no inhabited areas shall be unsearched*; it is absurd—as has been found to be the case in some areas—for the main villages to be inspected and hamlets to be ignored. On entering a village, he should send for the Village Head. He should consult with him as to all new arrivals, and ascertain if they come from infected areas. He should inspect the Village Register maintained under Regulation 17—vii, and see that all arrivals from infected areas have been given passports under Regulation 17-v. He should then personally inspect all persons holding passports, and endeavour, by careful enquiry of inhabitants, to ascertain whether strangers, other than those reported by the Village Head, have arrived. All persons encountered whom the Village Head cannot account for should be questioned as to whence they have arrived, with the object of ascertaining if they are persons who have evaded the passport Regulations. For this purpose, the Sanitary Inspector may detain persons from infected areas not possessed of passports, or, who, having received passports, fail to fulfil the terms. In both cases, the detention can only be of such a nature as to enable the offender to be handed over to a Plague Authority (*Vide* Additional Regulation 7). Whilst making enquiries of this description, he should never fail to explain to the villagers the reason for enquiries, and to point out to them how, by coming to an agreement amongst themselves, not to admit to the village their relations and friends, or strangers, from infected areas, and by reporting instantly all cases of suspicious fever, they can prevent the arrival of plague amongst them. He should then search from house to house for cases of continuous fever, of more than twelve hours' duration. Of these, a register should be kept by the Village Head, who is required to watch carefully their progress, and, where suspicion is aroused by the symptoms and prolonged nature of the fever, he would be expected to send a special report to the Sanitary

Inspector. If it is found the Village Head failed to register such cases, or to report them when of a suspicious nature, the fact should be brought to the notice of the Plague Supervisor promptly. Cases of this nature should be carefully examined by the Sanitary Inspector, and the instructions given at page 45 be held in mind.

During his passage through the village, the Sanitary Inspector should observe its general state, and make notes in his diary, for report to the District Medical and Sanitary Officer, through the Plague Supervisor, of sanitary defects of *an urgent nature*—more especially as to conservancy, water-supply, overcrowding, and dampness of the surroundings of dwellings due to sullage, surface, or subsoil water. It must be distinctly understood that the writing of sanitary reports in detail, is not the important function he is expected to fulfil. His great end is the taking of measures to detect imported cases of plague, with such rapidity as to prevent possibility of indigenous cases supervening. At the same time, he should be able to effect much good by calling attention to gross sanitary errors that can be easily remedied. For example, inefficient protection of water-supply can often be corrected by cheap mechanical expedients, or by the shifting of the position of clothes washing sites, outlets of drains, bathing sites, places for burial, unsuitable rubbish depôts, badly placed latrines and easement grounds, likely to induce defilement by surface or subsoil soakage. The removal of rubbish and of night-soil are matters that he must deal with, as far as feasible, by personal influence with the people of the village, and by representation made personally to the Tahsildar, and other Revenue Officers when he meets them on tour. It is of no use making statements on the subject in his diaries, unless the condition be unusually bad; as nothing short of provision of special conservancy staffs and plant could secure adequate improvements in villages. It is only in large villages—Unions—that any systematic attempt is made at present. Still, good may be done by

frequent appeals to the people made in a kindly manner. Experience shows that villagers *can* be persuaded to put the whole of their rubbish and manure outside the village, and to cease defæcation within inhabited areas, if addressed by men in whom they have confidence. Unvarying courtesy and perseverance will, in the end, secure the results required.

All dhobies' washing grounds, cremation and burial-grounds should be inspected. If in a position to cause contamination of water, the fact should be reported, and the feasibility of securing other spots should be definitely ascertained. In the case of cremation and burial-grounds, marks showing the recent disposal of the dead should be invariably looked for, and the Village Head should be required to account for them. Lastly, the death and birth registers should be examined. If the death register for a previous period be available, corresponding parts of a year, when free from epidemic diseases, should be compared with the present period. The cause of each death should be discussed with the Village Head, and, if necessary, the relations of the persons concerned should be questioned. If there be cause for suspecting concealment of cases of plague, the grounds for suspicion should be reported to the Plague Supervisor. The occurrence of mortality amongst rats, squirrels, monkeys, and cats should be enquired into. The importance of killing healthy rats, so as to diminish the chance of conveyance of plague microbes, should be explained to the villagers, and the offer of such reward for killing rats as is sanctioned by the Collector should be made.\*

It need hardly be said that the intelligent Sanitary Inspector will not confine himself to ascertaining facts only when inspecting villages. He should keep himself well abreast of passing events, by cultivating the acquaintance

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\* A mixture of tar and sulphuric acid poured into rat holes, or so disposed as to make a circle round goods to be protected from them, is said to be an effective way of getting rid of them.



of the people at his headquarters. Facts of importance may often come to light by scraps of news about the movements of villagers being made known to their relations resident there. When journeying from village to village suspicious cases, suspicious events, and corpses should be looked for. The overhearing of a casual remark by a class of persons accustomed, during conversation in the open air, to shout at the top of their voice, or groans from a cart, may save a village from the horrors of indigenous plague, if action on information thus gained be prompt.

### **The Duties of Sanitary Inspectors attached to Observation Circles in Municipalities.**

The Sanitary Inspector of a Circle is responsible for tracing cases that have attempted to evade the passport system. Not only should he, on receiving intimation from the passport officer of failure to attend by any person reported to have residence in his area, energetically search and enquire for his whereabouts, but should also report to that Officer all arrivals of whom he has suspicion of their coming from infected areas without passports.

When in charge of a preventive or observation circle, the Sanitary Inspector should be capable of daily inspecting the sanitary condition of a number of houses, irrespective of the ordinary enquiry from house to house as to the existence of suspicious cases, and frequently repeated patrol of the whole area under his charge. When no disinfection work is on hand, besides this patrol, not less from 80 to 100 houses should be inspected daily. If under a careful Plague Officer, the Sanitary Inspector will find that his hours of duty are defined, and that he will be expected to remain in his Circle on active work during the period appointed. The Plague Officer will doubtless visit his Circle at irregular hours, and thus make certain of the presence of the Sanitary Inspector, and will arrange that at a stated hour, all the additional sanitary staff of the whole town are assembled at a convenient spot, where the full reports of work done can



be examined. These reports might be kept in the forms given overleaf. After perusing these, the Plague Officer should be in a position to issue orders to his temporary sanitary staff, and hand over to a representative of the Municipal Council (who should always be present at the daily assemblies) matters for disposal that would ordinarily come under the Municipal Council. In this way, recommendations as to improvement of houses and sections of the town made by the Circle Inspectors can be given rapid effect to, by *the permanent sanitary staff*. If a few coolies be attached to the Circle Inspector on observation duty, it is always possible for him to make improvements in respect to various petty sanitary details, without further reference. In this way, during the period of observation, by daily giving strict attention to work fulfilled, much can be done towards the important work of preparing the town to resist invasion.





The duties of the Municipal preventive staff in dealing with cases of plague must necessarily be, in practice, much the same as those laid down as to sanitary treatment of imported and indigenous plague, as stated at page 57, and need therefore not be here repeated.

By systematically filling the forms for "infected houses", much useful information may be accumulated that will give guidance in comprehending the preference of plague for certain houses and localities.

### The Duties of the Sanitary Inspector with reference to Plague.

It may happen that the Sanitary Inspectors may receive reports that prove to be unfounded. He is, therefore, apt to become sore as to the amount of trouble useless journeys have caused him, and incline to the belief that genuine cases will never occur. No Sanitary Inspector, however, worth his salt will allow such feelings to overcome his sense of duty. Should he be called upon to undertake journeys, that turn out to be useless, let him congratulate himself that there is really no plague within his circle, and, above all, not give vent to his ire by "bahaduring" over the village heads, or other persons who erroneously sent for him. On the opposite, he should take care to impress upon them the fact that he is officially much obliged for their promptness in communicating their suspicions. It is only on the understanding that possible mistakes will be treated in this spirit that they can be induced to report suspicious cases. The Sanitary Inspector should, therefore, make it known to them, when first joining his appointment, that they should have no hesitation in communicating with him as to any case concerning which they entertain the slightest suspicion. If this be not done, they will wait till death after death in the village leaves them no alternative but to report the existence of plague. It need hardly be added that, on receipt of a report from any official source, or on information being gained by his own enquiries, the



Sanitary Inspector must proceed to the locality indicated with the utmost dispatch.

It must be distinctly understood that the Sanitary Inspector is not the person who will be called upon to definitely and finally pronounce a case to be plague; it is for him to report "suspected plague," although, in submitting an official report on the subject, there is no reason why he should not state that from the symptoms observed (which should be fully detailed) he, personally, has no doubt on the matter.

### Examining Suspicious Cases.

On entering the dwelling, the Sanitary Inspector should do his work of examining the case without fuss. The patient himself should be addressed with re-assuring words; every politeness and consideration should be shown to the other occupants of the house. It must be remembered that concealment of cases is frequent, and that every effort may be made to mislead by information given as to the nature of the disease and the history of the patient, and to hide cases, or even corpses, in various parts of the house. The truth of the statements must, therefore, be carefully sifted, and no place be left unsearched with due regard to caste, religion, and race. The patient should be examined for the existence of buboes, and for this purpose the state of the neck, the armpits, and the groins should be carefully ascertained. It frequently happens that in these situations, even before pronounced enlargement of the glands gives rise to buboes, there will be tenderness over their sites, and this fact should be held as adding to suspicions as to the nature of the case. In examining the groins, it must be remembered that although the glands in the groins (inguinal) properly so-called are most frequently enlarged that, at times, those in the upper and flat anterior third of the thigh (the femoral glands) may be affected. Not necessarily in all cases, but in the majority, there is surrounding the enlarged and hardened portion of the bubo an

area of softness or doughiness, which is characteristic. This is due to effusion of blood, and of blood products, in the loose tissues round the glands. In the case of a female other than a mere child (and then only in the presence of its relations) it would be improper for a Sanitary Inspector to examine the state of the groins. If no woman whose word he can trust is at hand, such as an officially employed midwife, he must be content with concluding that with the symptoms as to temperature, facial expression, condition of tongue, and attitude, he has sufficient grounds for suspicion.

It must not be forgotten that symptoms must not be judged singly. Thus, a man might have a bubo in his groin due to venereal disease. In this case, fever is not likely to be present, and question (or examination with the patient's consent) would show that a sore existed on the private parts. But it must not be forgotten that it is possible for venereal disease to co-exist with plague.

Again, nothing is more common than the existence of fever due to malaria. Hence, it would be erroneous to conclude that a case was plague merely on account of the existence of fever. Malarial fever has roughly two types—an intermittent and remittent form. The former represents the ordinary type of fever in which, preceded or not by shivering, there is fever of from two to six or more hours' duration, ending in a fall to the normal temperature, with or without perspiration. The latter is the less frequent form—in which fever may be present for several days. In this case, there is a more marked and regular tendency than in plague for a fall of temperature in the early morning. The skin in remittent fever is seldom otherwise than slightly moist, and at times the patient breaks into perspiration over the whole body. In plague, however, the skin remains pungently hot and dry, except that occasionally the forehead becomes moist. The finding of buboes would, of course, be a great help in coming to a conclusion; but a case that may ultimately prove to be genuine bubonic plague

may show no buboes for from two to five days. Moreover, the pneumonic, intestinal, convulsive, and toxic forms may not be attended with buboes throughout the disease.

A considerable guide would be obtained by ascertaining the mode of commencement of the attack. It is rarely, in a person affected with malaria, that feelings of uneasiness and chilliness, followed by a prolonged cold stage, do not precede the fever; but plague is commonly ushered in with a short rigor followed quickly by high fever, while there is much pain over the forehead, and, at times, persistent vomiting. In the intestinal form of plague, although during frequent motions there is a tendency to collapse, there is not the cold clammy skin and sunken eyes of cholera. In all cases, the pulse is usually soft and rapid, and, if the patient be sat up, it will be found to get rapidly small. Such a test, however, should be avoided, as the patient is apt to faint and die.

Hence, in coming to a decision as to whether the case dealt with can be justly classed as one of suspected plague, the symptoms of the disease *special* to the various forms must be judiciously considered (p. 12), and particularly those described as "common" to all forms of plague (p. 9). When, then, with continuous fever of over twelve hours' duration, the symptoms *common* to plague are exhibited, and *especially when there is a history of having arrived from an infected area*, of having been in contact with articles susceptible of infection from an infected area, or of living within an indigenously affected area, the Sanitary Inspector would be justified in reporting the case as of "suspected plague."

*Examination of a body dead of plague.*—The concealment of cases of plague, the desertion of the sick and dying, and the tendency above described for the patients to wander aimlessly, demands that the Sanitary Inspector shall make himself acquainted with the appearance of plague corpses. The following description is derived from General Gatacre's Report on plague in Bombay:—



“If the position of the body has not been altered after death, it will invariably be found lying on either side with the knees flexed and the head leaning towards the chest; rigor mortis is delayed; there is softness and want of cohesion of the fibres of the muscles; the thumbs point towards the palms of the hands; the features have a fixed anxious expression; the eyes are sunken and muddy in aspect with a peculiar lustre of the cornea, the pupils being dilated and the lids half closed; the tongue is swollen and coated with fur of a glistening appearance, and is clean at the tip and edges; the fur is dry, white or yellowish-brown, cleft down the centre, and horny. The complexion is opaque and dingy, the skin is dry, and if death has been recent, the forehead and hands are cold and clammy, and enlargement of the glands in one or other locality would decide the opinion that death had been due to plague.

“If death occur during delirium or convulsions, there may be distortions of the features, in which, if the patient dies while on his back, the head is thrown to either side and the legs are separated. Petechial spots may also be noted, although in the epidemic in Bombay they have been comparatively few. In death from pneumonic plague the body and face have a dusky bluish livid hue, spatum hangs round the lips, and the body seems shrunken and collapsed.”

### Action to be taken pending arrival of the Plague Officer.

Having decided that the case is one of “suspected plague,” the duty of the Sanitary Inspector is forthwith to obey Additional Muffasal Regulations Nos. 18 and 19, which run as follows:—

18. “The Plague Inspector and the Tahsildar shall inform all superior officers up to the Collector by the quickest possible means, and shall go at once to the village. The Tahsildar shall arrange to be accompanied or followed



by the nearest Medical Officer with a supply of medicines and disinfectants, and by a staff of constables and peons.

19. "On arrival at the village, the Plague Inspector (or Medical Officer if there is no Plague Inspector) shall supervise the isolation of the patient and the disinfection of his residence, clothing and excreta, and the person and clothing of his attendants, and shall continue such supervision until relieved under the orders of a Plague Officer and sent back to other duty."

From the above, it will be seen that the Sanitary Inspector is intended to be the first person to act with the Village Head in securing that no spread of the infection shall occur, by employing such temporary means as are at command, pending the arrival of officers armed with more authority, and the decision by a competent Medical Officer as to whether the "suspected" case be one of genuine plague. In this respect, the Sanitary Inspector occupies a position of much trust; as should he not, during the interval, energetically exercise correct measures, the infective matter may be so scattered before the arrival of the ambulance staff (*vide* page 24), that any efforts subsequently made may be minimized in value. This staff includes a Sanitary Inspector who will, unless the Plague Officer otherwise orders, relieve the Circle Sanitary Inspector of local duty. It will, therefore, be understood that, until the arrival of the ambulance staff and receipt of orders on the subject, the Sanitary Inspector of a Circle must desist from undertaking routine inspection of villages, and must devote his attention to the prevention of spread of infection from the ascertained case. This, of course, must be interpreted with discretion; as if a further suspicious case were reported in a village within a distance that would imply but a short journey, it would be necessary for him to proceed there, and make temporary arrangements also.

Any tendency on the part of the villagers to resist the orders of the Village Head should be dealt with by patient

explanation of the reasons for measures taken, and by seeing that in their execution nothing is done that can reasonably be interpreted as an offence against caste, race, or religion. Any arrangement that the Sanitary Inspector thinks necessary, but finds is likely to be *actively* resisted, should not be enforced until, on the arrival of the Plague Officer, he receives definite orders. Thus, whilst Additional Regulation 17 requires the Village Head to effect isolation the patient, and all who have been in attendance, or in contact with him, in a hut or shed remote from inhabited houses, it may so occur that he has insufficient influence to compel these precautions. Before deciding to abandon this important measure, however, the Sanitary Inspector should in simple language explain to the people concerned, firstly, the importance of the healthy being separated from the sick, so as to stay the spread of contagion and thus prevent further risk both in the house attacked and in its neighbourhood ; secondly, that persons who have been in contact and are apparently healthy will simply be segregated so as to be maintained under observation for ten days, and, during this period, will be subjected to no difficulty as to receiving food of their own preparation, or as to receiving food and water in strict accordance with caste requirements ; thirdly, as to the sick person, that, in respect to nourishment, nursing, and the administration of medicine, their relatives can make their own arrangements ; and fourthly, that to take correct care of the sick a reasonable number of relatives—usually two—will be permitted to accompany each sick person to the building or shed where isolation is to take place.

### Precautions to be followed if the Patient be isolated.

It being arranged that the patient is to be removed to an isolated hut or building, the transport should be carried out as described at page 84. Provision for receipt of all excretions and infective matters should be attended to on

the same principles as if "home segregation" were practised (page 53) during the whole period of the patient's isolation.

The Sanitary Inspector should note carefully the names, occupation, and addresses of all "contacts." These also should be placed, if feasible, in a shed or building, preferably, outside the village, after disinfection of their clothing and all property. An efficient guard (in absence of police, village servants should be employed) should then be appointed, with orders to prevent egress without permission beyond any suitable bounds. Over the house or hut in which are sick persons and these attendants, a guard also should be arranged for.

The Sanitary Inspector should ascertain from the patient (if capable of the exertion of talking and sensible) from whence he came, and endeavour to trace with care in what manner he contracted infection. This information having been gained, the next step should be to find out to what extent the patient has himself been the cause of scattering infection.

So far as our information goes, at the present time, it would appear that a bubonic case need not be feared as to spread of infection by escape of the plague microbe from the discharges, until, in the late stage of the disease, the glands have failed to effect their duty of preventing the microbe entering the circulation, and thus making their appearance with blood passed with the urine and fæces, and, possibly, from the mouth and the nose. On the other hand, it is certain the sputa from pneumonic cases are loaded with microbes, and therefore are liable to infect dwellings in a high degree. With such distinctions, however, the Sanitary Inspector should not trouble himself; exactly to what extent and at what stage infection is possible from the varieties of plague, must await further investigation. The only safe course for him to adopt, in the public interest, is to assume that the discharges of all plague cases are infections at all stages.



This being so, it follows that he should ascertain from the patient, or his guardians, precisely where, prior to discovery of the case, the patient's excreta and discharges have been disposed of from day to day. These possible sources of infection must be definitely traced, and the various places be fully disinfected. If excreta be found, it must be burnt after the addition of carbolic sawdust, or, if this be not at hand, paddy husk or other easily ignited matter such as brushwood, kerosine, etc. The stained parts should be fully burnt over with "bratties" or straw; or a solution of perchloride of mercury may be used (1—1,000) or sulphuric acid (1—250)—the latter being preferred in instances where the ground to be disinfected is characterized by slimy mud.

If a drinking water well or tank has undergone risk of contamination by ablution, washing of clothing, or dipping of vessels by the suspicious case or the "contacts," disinfection should be carried out with either the permanganate of potash, or by the lime and alum process (page 118). Private wells in infected premises should be invariably disinfected. In default of another source being available, persons using the water should be advised to boil it, notwithstanding its disinfection.

It must be remembered that not one dwelling or one source of water-supply, or the soil in one locality only need have been contaminated by the patient, but that he may have changed his residence from time to time in the same, or neighbouring village. It is the duty of the Sanitary Inspector to ascertain the full facts, and not to relax his attention till he secures all details. He should act upon the facts ascertained with as little delay as feasible.

Attention should next be directed to the question of clothing, and other articles within the house specially liable to being infected. Careful search should be made for rags that have been used in wiping the patient's mouth, or other nursing operations, on which the excretions are likely to have the chance of adhering. Worthless rags and rubbish of all description found in the courtyard and premises should be



burnt in the courtyard, or, failing there being one, in the front of the house; the reason for so acting being carefully explained to the patient's guardians. Clothing and articles that can be washed should be disinfected (page 92). It should then be ascertained where the patient was in the habit of washing his clothing or, if he has sent it to a dhobie, where this man washes. The well or pool where washing has occurred should be disinfected with permanganate of potash, or the alum and lime process, according to the size. Where dhobies are concerned, it is well to cause them to shift their stones entirely from the old places and start new sites (even if it be but a matter of few yards) so as to secure clean soil. The old sloppy and muddy site should be disinfected with the sulphuric acid solution. The dhobies' houses and its contents should be fully disinfected, including the clothing of customers other than the plague case; as it must be remembered that the dhobies ordinarily store clean and dirty clothing in the same room.

Complete disinfection of the vacated houses would usually be effected on the arrival of the Plague Officer, when the procedure laid down at page 85 should be followed. After effecting the precautions stated above, the house, therefore, should be locked, so that no one can enter it.

### Arrangements suitable for "home segregation."

If it has been determined not to move the sick person, after having attended to the points already detailed above, the Sanitary Inspector should see how far he can improve generally the sanitary condition of the house in which he dwells. Where ventilation is defective, he might, with little persuasion, make suitable openings in the roof or side walls; but if this is likely to cause much dissatisfaction or cause discomfort, he must content himself by requiring that all doors and windows be kept fully open. If it be possible to erect a hut on the land attached to the house, or even to make suitable temporary shelter on the roof for the patient, it would be preferable to allowing him to

occupy a room in the dwelling shared by other persons. All rubbish in the backyard or the surroundings, especially old rags, should be collected and burnt. All slimy mud spots at the front and back of the house should be disinfected with the sulphuric acid solution. All stained portions of the floor near the patient should be disinfected with perchloride of mercury solution. Full arrangements should be made for the collection of all excretions in small, preferably tarred, "chippas." Having regard to the possibilities of accidents with perchloride of mercury, even where the colouring matter is added, in dealing with an ignorant population, it is probably best to use carbolic sawdust as a disinfectant. The guardians should be required to place all urine and fæcal matter and discharges from any source into "chippas", in which the carbolic sawdust (1 in 10) has been kept ready. Particular care should be taken to instruct that the sputa of pneumonic cases be received in the "chippa." At intervals of not more than four hours, the special toty on plague duty should call, under the immediate superintendence of the Sanitary Inspector, to remove the whole for the purpose of being burnt in the front of the house, or, better, in the private courtyard. Enquiries as to dead rats or mice should be made, and, on these being found, they should be burnt. The people in the house should be warned to kill these also, and, without direct handling, destroy by fire any subsequently found. Special orders should be enforced that sweepings of the house be not thrown in the street or public dustbin. They should be collected in a kerosine oil tin, or broken chatty, and be burnt by the toty in the presence of the Sanitary Inspector on each visit. In the case of those who have volunteered to remain with and nurse the patient, the precautions mentioned at page 73 should be impressed upon them, and phenyle solution (1 in 100) should be provided for disinfecting their hands. The advisability of only those who have undergone inoculation undertaking this duty, should be pointed out to them.

## The Contacts.

The Sanitary Inspector will now have time to turn his attention again to the "Contacts." It has already laid down, in reference to these persons, that no clothing or other article whatsoever that has been in risk of contact with infective matter should be removed to the new abode, unless complete disinfection has been effected (page 92). In the case of contacts, search should be made for the dhobie employed by them, or the usual private washing place, and the procedure stated at page 53, with reference to the clothing of infected persons, should be equally followed.

Up to date, it has not been shown that the excreta of "apparently healthy" persons, who have been in contact with infective matter, contains the plague microbe. But as it is partially granted that infection can occur by the bowels, and it is known that the plague microbe can undergo modification as to virulence, it may yet be ascertained that, as in cholera, the intestinal tract may contain the pathogenic microbe, although the bearer does not himself present symptoms of the disease. Hence, as a matter of precaution, all excreta of contacts should be collected separately from the rest of the village population, and be burnt with the rubbish from the residence. Where the amount of excreta is too large to be burnt on the spot, it should be collected in separate receptacles, and be removed to a depôt distant from the site for the healthy population. Here the excreta may be buried in the trenches of the usual form, but a layer of quick lime should be added above them. If a house in the village has been temporarily occupied by contacts till suitable huts have been erected, as soon as the transfer is made, the house should be completely disinfected.

## Medical Treatment until the Ambulance Staff arrives.

It is not likely that guardians of patients will frequently request advice as to treatment in cases of plague. The



Sanitary Inspector should, when allusion is made to this subject, impress upon those concerned that it is not his business to interfere with medical treatment, and that all he requires is their co-operation in preventing spread of the disease by destroying the infective matter. Nevertheless, some utility may be served by the Sanitary Inspector particularly warning the people against lifting the patient to the sitting or erect posture for any purpose whatsoever. The mode of death in plague is usually by failure of the heart's action. Any attempt to raise the patient tends to bring about a great strain upon the heart. Hence, general directions should be given to keep the patient in the recumbent posture; to allow free ventilation of the room and building; to refrain from aggravating the high temperature by piling clothes upon the patient; to give nourishment systematically of an easily digestible nature such as conjee made with milk, milk, and mutton and chicken broths, where caste does not prevent these being used. Where there is no caste or religious objections to its use, good arrack may be used in small doses, diluted with water, at such intervals as may seem necessary to maintain the patient's strength. Mild laxatives may be given in cases where there is marked constipation.

### House-to-house Inspection.

The foregoing details having been attended to, the Sanitary Inspector should conduct systematically a house-to-house inspection, and continue it subsequently daily, with the object of gaining early information as to further attacks, and taking prompt measures thereon. Seeing that the majority of Sanitary Inspectors employed are men of good castes, it is not likely that any opposition to their entry to a house will be encountered. Such entry should, nevertheless, always be conducted with the utmost courtesy and consideration. During search, every opportunity should be taken to impress the inmates with the absolute necessity of at once reporting any fever case that may occur in their



own houses, or that of their neighbours—so that the village might be spared from the otherwise certain calamity of the disease spreading throughout the population. House searching must not be conducted in too confiding a spirit, however fair and apparently genuine the words of welcome on entrance. It may frequently occur that whilst all the inmates pretend to be busy about their usual occupations, they are in reality doing their utmost to misguide the Inspector. A look behind a bamboo screen, or into a dark windowless room, may reveal the sick or corpses carefully concealed. In villages where Vigilance Committees (*vide* page 27) have been formed, the Sanitary Inspector should ally himself with the members, and do all he can to encourage them to perform their duties honestly and regularly, by impressing them with the great advantages that must accrue from early detection, and correct sanitary treatment, of cases.

### Dealing with an indigenously affected area.

In the preceding paragraphs, it has been supposed the Sanitary Inspector has had to deal with an imported case of plague. When, however, plague is “indigenous,” in the sense that all possibility of tracing the mode of infection of the population is lost, and it is no longer possible to deal systematically with house after house, sanitary effort must extend to groups of dwellings instead of to solitary houses.

It is often asked why plague should not be dealt with on the same system as cholera; that is, allow the sick—otherwise than in cases coming under Section 233,\* District Municipalities Act—to remain in their own homes. It is a

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\* When a hospital or place for the reception of persons suffering from any dangerous infectious disease is provided within the limits of any Municipality, the Chairman may, on a certificate signed by a certificated medical practitioner, arrange for, or direct, the removal to such hospital or place of any person suffering from a dangerous infectious disease, who is, in the opinion of such medical practitioner, without proper lodging or accommodation, or who is lodged in a room occupied by more than one family.

proverbial saying that different diseases demand different remedies ; this is specially true of cholera and plague. In the case of cholera, the source of infection is usually water that has by some vile carelessness been contaminated with the cholera microbe, with the result that a large proportion of those using it may be attacked. Such attacks necessarily are spread throughout all portions of the town using the contaminated supply. Against this disease, having regard to the knowledge possessed of its usual source, in protection, disinfection, and boiling of water, we have remedies that if put in force with vigour only require the co-operation of the people to secure rapid immunity from spread of the disease. Even should the disease not be checked by appropriate means directed towards the water-supply, the cholera microbe has a tendency to undergo early change in virulence, so that usually by the end of three weeks, if further sources of water-supply have not been contaminated, a village may be free. The course of matters is, however, very different in the case of plague. Although there is reason to believe that water may be contaminated by the plague microbe (page 64), and the disease may therefore be thereby transmitted, it is not likely that it would survive in water for anything approaching the period that the cholera microbe obviously does, even granting that certain changes of form are undergone ; but, as to this subject, it is probable more direct proof may be forthcoming, when more of the sanitary condition and history of villages, where unprotected water-supplies have existed during epidemics, is forthcoming. Be this as it may, the great distinctive peculiarities are that whilst cholera within a few weeks may spread over the whole of a town or village, carrying off in great rapidity numbers of people, and then suddenly cease to slay, plague, on the opposite, commences by attacking one or more houses, and confining itself subsequently to those in the immediate neighbourhood ; extending thus slowly and steadily, it may be not till the lapse of some weeks, that it will obtain such a hold upon a town as to commit anything like the havoc of an ordinary



epidemic of cholera. But, then, a vast difference is perceptible ; slow though its progress may have been at its origin, once it has established itself, its stay is not for a few weeks, but almost certainly for a couple and, it may be, for more years. Cholera quickly gathers its victims and departs ; plague commences work with a deceitful mildness that lulls its victims to a sense of safety ; but, in the end, so far as localities favourable for its continued vitality and propagation are concerned, its demand for victims is greater than in the case of cholera. It is this persistent and insidious demand for life, and the great hold it usually obtains upon a population before real alarm is felt, that makes it so much dreaded. This dread is accentuated by the fact that in those who have not been protected by M. Haffkine's inoculation, the rate of mortality is, unless active treatment and careful nursing be exercised, rarely less than 80 per cent. of those attacked, as against 45 to 50 per cent. in cholera.

From the above, it will be gathered that slowness in establishing itself in a population is characteristic of plague ; and that a second characteristic is that, instead of spreading over a whole town at once, it at first confines itself to groups of dwellings in a limited area. If these two facts be taken correct advantage of, the sanitarian has reason to believe that plague can be successfully combated. Its slowness in progress points to the enormous advantage of having a population under a system of "observation," of which the details are so organized that each imported case shall be promptly dealt with. The experience of this Presidency, under this system, goes to show that unlimited numbers of "imported cases" may be received and be safely dealt with in an unaffected territory, and that it is only concealment, or other cause bringing about neglect of sanitary precaution, that ensures an epidemic, by the disease becoming "indigenous." When this occurs, the fact that it confines itself to groups of dwellings, gives hopes that first efforts may be reasonably confined to small portions of

inhabited areas : so that, if efforts be made with sufficient promptitude, there would still seem open to the sanitarian a second chance—if by an unhappy combination an imported case has not been correctly dealt with—for crushing the disease before it becomes seriously epidemic.

Practical experience shows that next door, or immediately to the rear of the first house affected, or, at least, in its close vicinity, a second house will be attacked, that close to this another will follow, and so forth. Indeed, where the houses are flat-roofed and it is possible to survey from one of them the neighbourhood, the observer will be struck forcibly with the fact that the plague has worked in an area that can readily be demarcated. So much is this the case that, unless the spread of infection has been allowed to get extensively out of hand, by want of prompt sanitary action, a circle of 50 houses round the first infected house will frequently include fully the whole area attacked.

Now, although the plague microbe has not as yet been demonstrated in infected houses, it is unquestionable, from experiments conducted by Mr. Hankin upon purposely infected mud and cowdung plastered floors, that the microbe does survive within dwellings, and also that it is especially favoured in its vitality by absence of air in motion, light and the direct rays of the sun. Irrespective of bacteriological enquiry, there is evidence that families returning to houses where cases have occurred have again been infected, and this after the lapse of an interval that would leave no doubt that the infection was not due to the original cause. In short, infected houses must be regarded as foci of contagion of a persistent character.

When, therefore, cases of plague occur, and the chain of infection is lost, by reason of defective information secured from the inhabitants, and by it being ascertained that rats in the area are dying, *the best resource of the sanitarian is to at once effect evacuation of all houses within the suspected area.*



It is frequently contended that this advice may be sound enough in respect to villages, but is absolutely inappropriate to large towns. Admitting that certain of the difficulties attending evacuation are increased, in the latter case, and that at times it would be inappropriate, the true answer to such an objection would be that the greater the number of inhabitants in quarters of a town still unaffected, the greater the reason for evacuation of an area indigenously attacked, seeing that delay inevitably means further spread of the disease. But, as a result of apathy or ill-defined policy, to allow indigenous plague to spread hither and thither over a large town, *and then speak of evacuation*, would certainly be inappropriate; what is here contemplated is *prompt* action the moment plague is declared indigenous—such action involving, it is believed, almost universally, in the early stages, but small and manageable areas. It is practically certain that if the local authorities neglect to effect the evacuation, the day will come when, after being subjected to useless loss of trade and of life, the inhabitants will have the fact forced upon them, by bitter experience, that this policy is essential. Then will follow evacuation by popular accord—the offspring of fear—too late, however, to be effectual; the inhabitants will now stream towards distant villages and towns conveying disaster and death with them. In short, to promptly evacuate indigenously affected areas is sound, sanitarily and economically.

The decision on a point of this importance necessarily rests with a Plague Officer, and not with the Sanitary Inspector. But the Sanitary Inspector should prove himself of utility, in aiding the defining of the area required to be evacuated. In arriving at an estimate of the number of houses that must be evacuated, it is well to attempt to secure some marked feature that shall clearly define the area. Thus, lanes, streets, or streams should be selected, so as to make distinct boundaries.

Before evacuating an area, necessarily definite ideas

must be formed as to how the inhabitants are to be accommodated during temporary absence from their houses. Not only have "contacts" and those actually suffering from the disease to be provided with temporary accommodation, but the "apparently healthy" persons. Hence, there must be provided "a health camp," "a suspect camp," with an observation ward attached, and a Plague Hospital.

### Preparation before moving into Health Camps.

The Plague Officer will inform the people as to the date he expects them to evacuate the houses. The order should be accompanied by the free distribution of handbills in the vernacular containing, as an appeal to Hindus, the Shastras referred to at page 155 of Part II., and as an appeal to the Mohamedans, the statement of Professor Khaleed Ahmed, given at page 163. When possible, it would be advisable that Regulation 34, which runs as follows, should be put in force:—

"Special passes may also be given freely, especially at the beginning of an epidemic, when a plague authority is satisfied that no case of plague has occurred in the house of the applicant, or in any adjacent house, or among any of his relations or associates, provided that the plague authority may always require the disinfection in a prescribed manner of all clothes and other articles to be taken away before a pass is given. When the applicant is known or suspected to have been exposed to infection, no officer shall grant a pass until the applicant has been kept under medical observation (1) for a period which may extend to ten days, (2) or until the reasons for suspicion have disappeared. In such cases disinfection of clothes, &c., should always be insisted on. In this rule, "applicant" includes all the persons in a household on whose behalf a special pass is applied for."

A special office should be opened at a convenient spot in the village where the Plague Officer, or other person

appointed by him, could be interviewed by the people on all matters concerning evacuation. It would then be announced to the people that for the poor unable to pay for erection of shelter, suitable huts would be provided at Government expense. The huts so provided should be numbered on a rough plan of the site, and tickets with corresponding numbers should be given to applicants. When the persons are well off, sites should be numbered and then be similarly assigned to them, for purposes of building at their own cost.

When the tickets are handed to the applicants, it should be made known to them that it is of the utmost importance before entrance to their new homes that the clothing of the whole family should be subjected to boiling, that all dirty rags should be burnt, and that foul mats and pillows shall be similarly disposed of, and that all articles that cannot be treated with boiling water or destroyed, should be exposed to the direct rays of the sun for eight hours. As to life in camp, applicants should be told they will be regarded as free to go and come as they choose, with the exception that they must not enter the infected area of the village, without the written permission of the Plague Officer. To enforce this precaution, it need hardly be said that as soon as the area is evacuated, a suitable guard must be placed on night and day duty.

The Sanitary Inspector should ascertain definitely from the Plague Officer what arrangements are to be made for the safe custody of articles of value that the people would wish to leave behind. Whatever these arrangements are, he should aid in making them freely known ; as, in practice, it at times occurs that the only reason a villager has for objecting to evacuating his house is that he has property, money, or jewels he believes would not be safe in camp.

To effect the above measures with reference to an undisciplined crowd of people, is not an easy task ; still



their confidence can be gained by an unreserved explanation of intentions, when all troubles on the subject of evacuation will generally disappear.

### General Sanitary efforts pending evacuation.

It being known that plague may exist in modified forms and that, as a fact, at times persons will actually perform labour up to the hour of their death from plague, it follows that such persons may have, in public latrines and elsewhere, passed excretions that are infective. Irrespective of it being possible, owing to the defective arrangements known to exist in villages, for water-supplies to be contaminated by the feet of persons passing over soil so infected, and of even direct defilement by flow from the surface to water-supplies, deposits of fæcal, and household waste, matter may serve as the points whence the living microbe may be transferred to food or water, or direct to human beings by adherence to flies, ants, or other insects that have been in contact with them. Very special care therefore must be taken to maintain the soil of an indigenously affected area in a high state of cleanliness, and to promptly remove anything that may give shelter for infective matter. To attain this end, latrines should be burnt over daily with straw—if necessary, with kerosine oil added. All sweepings from the streets and houses should be removed from the area in carts, that, if not provided with permanent covers, should have tarpaulins stretched over them, so as to prevent their contents being distributed, during transit, throughout healthy parts of the town.

It would be advisable to avoid transport, by using incinerators for consumption, *within* the indigenously affected area, of the whole of its rubbish. Where it is not possible to so treat the whole, it ought at least to be feasible to make small mud and stone, or mud and brick, incinerators, after the pattern of “chunam battis”, that should consume the rubbish of the chiefly affected street. In small villages where no arrangement for transport of rubbish



exists except by hand labour, these small incinerators can readily be made at convenient corners or spots with a little open ground, so that the whole of the rubbish can be got rid of by incineration, by direct deposit within them. Night-soil carts should proceed covered, and it should be seen that no filth adheres to the exterior of the carts during transport; if so, their surfaces should be disinfected. Rubbish transported outside the village limits should be burnt, if sufficiently dry; if not, it should be buried in trenches and be left undisturbed; it should not be deposited with the rubbish accumulated in former periods intended for sale. The night-soil should also be placed in trenches apart from those in general use.

The above requirements demand that for conservancy of night-soil and rubbish of the indigenously affected areas, completely separate staffs and plant should be assigned for duty; that is, the same staff and plant should not work partly within a healthy, and partly within an infected area.

In addition to the staff and plant set aside for general public conservancy, a special staff must exist whose sole attention must be devoted to the quick destruction, on the spot, of the rubbish and night-soil from houses where recent cases have been reported, or where "home segregation" is practiced. The staff for this purpose should be organized on the principle laid down in dealing with "observation" and "preventive circles" in Municipal areas (page 25).

Public wells should be hankinized every third day (page 124), and for tanks, or extraordinarily large wells, the alum process of purification should be used. Wells within infected private premises should invariably be hankinized. In Southern India, the people rarely object to these processes of water disinfection, if its object be explained.

## Formation of Camps.

Except in regard to providing "urgent hospital hutting" for the first plague patient in a village and for the accommodation of "contacts," it is not likely the Sanitary Inspector will have anything to do with building camps. Such matters will fall to Tahsildars and others, under the direction of the Plague Officer. Still, it is advisable the Sanitary Inspector should hold in memory the chief sanitary points involved, and the nature of the privileges allowed to inmates. Attention to the latter is desirable that he may be able to represent the truth to those who have to resort to the camps; as various falsehoods are frequently in circulation amongst the ignorant classes.

## Urgent Accommodation.

Until the Plague Officer arrives and gives orders for construction of more pretentious buildings for plague, the Sanitary Inspector, in consultation with the Village Head, may have to find accommodation for a plague patient in a building removed from the village, such as a well-ventilated muntapam or chuttram. Such arrangements would also serve for "contacts," who, of course, should also be accommodated in a building separate from the patient and the attendants. Where, however, such accommodation cannot be secured, rough huts should be made with the best haste feasible. The ordinary triangular hut, such as used by coolies on roadworks throughout the country, will suffice for "contacts;" but, for the patient, it ought to be feasible to make a small hut of the character described below meant for the accommodation of "contacts" in Government camps, but having an area of not less than  $12 \times 12$  instead of  $10 \times 12$ . The materials employed should be those in general use in the district concerned. These are cholum stalks, dal stalks, water-rushes, paddy straw, cadjan leaves, etc.

*Water-supply and Conservancy.*—It need hardly be said that arrangements must be made for obtaining water,

without sending vessels direct to the water-source from the hut either of the contacts or of the patient. Healthy persons should be required to draw and deliver into the vessels, at a small distance from the camp. In the matter of conservancy, all the care described under "home segregation" should be pursued.

## Public Camps.

### SITES.

In respect to sites for these camps, it would be preferable, though not essential, that a Plague Hospital be to the leeward side of the village, and that the "suspect" camp be within such a distance of it as shall enable any person found suffering from the plague to be removed to the camp without having to endure long transport. At the same time, the "suspect camp" should be at such a distance that no real or imaginary cause for fear need be present in the mind of its inhabitants. Holding these facts in mind, any convenient sanitarily suitable sites may be chosen; but the "suspect camp" should preferably not be nearer the Plague Hospital than 100 yards, and the Health Camp than 300 yards. Where, however, absolutely necessary, these distances may be much diminished with safety; as Plague Hospitals have been maintained when separated but a few feet from inhabited houses, without evil influence—a fact that of course proves not that these hospitals were no source of danger, but that correct disposal of infective matter was uniformly effected.

In selecting sites for these camps, care must be taken to see that they have either water-sources available, that wells can be cheaply sunk, or that water can be obtained by transport within a reasonable distance. In towns, these matters may be best arranged by extensions of existing pipe systems to the various camps. The site itself should be, as far as feasible, elevated and exposed to the prevailing winds; the ground should have a sufficient slope to readily carry off surface water. Black cotton soil should be



avoided ; a well-consolidated gravel soil with a gentle slope is the best form obtainable.

*Hospital Accommodation.*—The patient is entitled to a minimum of 2,000 cubic feet, and 144 superficial feet. Where funds and time are available, the floors of wards are made of concrete plastered with cement. These impervious floors have saucer-shaped drains leading to reservoirs, in which, at all times, is placed a solution of perchloride of mercury, with the object of securing disinfection of any washings from the floors. Where time and funds are not available, the floors are made of rammed gravel. Patches of these floors when defiled by patients are disinfected, removed, and replaced by clean gravel. Full details as to construction will be found in Part II., meant originally for caste plague hospital, but equally applicable to public hospitals.

Patients may have their own medical men to attend upon them, and be nursed by their relatives. Their own food and water, etc., may also be supplied. Special isolation of pneumonic cases is effected to prevent danger of spread in hospital from this highly infectious form : where this care is taken, experience shows that both the hospital staff and patients' relatives incur but little danger—in *well ventilated and sufficiently spacious wards*. Discharge from hospital is usually delayed, until one month after full subsidence of active symptoms, or one week from the healing of a bubo. During nursing, every care is taken to segregate all infective matters, and destroy them by disinfectants and burning ; beyond attending to these details and to ordinary cleanliness of the patient, no interference is made by the hospital staff with the patients, if the guardians so wish.

Relatives are allowed a hut measuring 10 × 12. It is well ventilated, and provided with a 5-foot verandah. Separate bathing places, latrines, and cooking places are set apart for relatives. Relatives cannot leave the camp without

the permission of the Medical Officer in charge. But where they could be trusted to return, this would no doubt be conceded, on their consenting to disinfect their persons and clothing before going out. Relatives who wish to leave as soon as the patient they have nursed is convalescent, need not remain during the month necessary for the patient. At any time they choose, they may subject themselves to the rules for "contacts," which imply ten days' observation from date of contact in the suspect camp, or under surveillance, as may be required by the Medical Officer.

### The Suspect Camp.

The following description is quoted from the Madras Plague Regulation and Rules :—

26. "The object of this camp is to afford shelter to persons who, it is suspected, may be undergoing incubation of plague, and whom it is determined to keep under observation so as to secure their isolation at the earliest moment in the event of an attack. This being so, it is evident that the camp should be arranged so that the shed occupied by a person eventually attacked may be destroyed or disinfected with the least practicable disturbance of sheds inhabited by the unaffected, and with the least expenditure. It follows that it is better to make each shed as small as compatible with the comfort of a single family, which may be taken as the unit. The average family consists of five souls. Where this is exceeded and, in consequence, overcrowding occurs, all male adults over 12 years of age should be provided with sleeping accommodation in huts separate from the family.

27. Each hut should afford an area of 12 feet in length by 10 feet in breadth. The roofing may be formed of any shape or material that can be conveniently obtained; but a plan having been adopted, it should be adhered to throughout the camp. Each hut should be 20 feet distant from its neighbour in the same line. Each line of huts should be 40 feet distant from its neighbour. Each line should consist of four huts; four such lines would form a block. Each block should be 60 feet distant from the neighbouring block. Blocks may be arranged in lines not exceeding two deep to any length desirable. If it be desired to make a second series of such blocks opposite to one already formed, an interval of 100 feet should be allowed. The second series of blocks should have huts *en echelon* with reference to those opposite to it. Where economy

of space is desirable, the intervals may be reduced to one-half the measurements here suggested.

28. In places where, in consequence of want of funds or space, it is found impracticable to construct, in accordance with Rule 27, separate detached huts, they may be replaced by large sheds, each containing twenty rooms in rows of ten arranged back to back. The rooms may be separated by partitions of matting, 7 feet high, so that the space under the roof slope will be common to all the rooms. No windows are necessary, and it will be enough to provide each room with a single door, 2 feet 6 inches in width.

[These huts are of a pattern not sanitarily commendable.]

29. Blocks should be distinguished by initial letters. This should be exhibited on boards placed in front of each. Each hut should have its number and block distinctly painted on a board, in white letters on black ground. The boards for huts should be large enough to allow the number of inhabitants to be shown in chalk letters.

30. No camp should contain more than 1,000 inhabitants. When more have to be accommodated, a distance of at least a quarter of a mile should be allowed between the camps. In this event, completely separate executive staffs should be provided for the respective camps.

33. Attached to the "suspect" camp should be an observation ward. This should be built for accommodation of patients at the rate of 1 per cent. of suspects. The design should be in all respects as stated in paragraph 8 *et seq.* In this ward should be placed persons who having fever or other complaints simulating plague must await the decision of the Medical Officer before transport to the Plague Hospital.

### Health Camp.

34. The object of this camp is to provide shelter for the healthy and those not suspected of being subject to incubation. The structure as stated for the suspect camp would in all respects suit, except that no fencing need be employed. It would, however, rest with the Officer responsible to use large huts for accommodation of several persons at a time, if it be found impossible to meet the demand for small huts on the family principle, on account of want of labour. In this case, sheds should be classed for males and females, respectively. Association in this manner is not likely to be otherwise than distasteful except to the poorest classes, and should not be followed unless excessive expenditure or absence of the necessary labour at command requires it. Sheds on this system preferably of the circular form described in paragraph 15, should be



made. These sheds might be arranged in triangular form so that the base of the camp is exposed to the prevailing winds.

35 Persons should be encouraged in the health camp to erect their own huts, but care should be taken that old material from unknown sources is not used in their erection. When persons build their own huts, the site must be carefully measured, and any attempt to exceed defined limits should be prohibited.

### **Water-supply for Hospitals and Camps.**

36. The water-supply should be secured from a source reliable as to its purity. When open water-sources are used, care must be taken to prevent contamination by plague-infective matter borne on chatties, ropes or hands. The only way to secure this is to see that no person connected with the handling of plague patients or the disinfection of material is allowed to have anything to do with the drawing of water or its distribution. In other words, specially-selected persons should be employed. If a stream or tank, the use of impervious platforms or special lifting apparatus designed so as to prevent contamination should be arranged for. Wells should be effectually covered in. Where pumps can be obtained and are suitable in respect to extent of lift required, these should be employed. If pumps are not employed, at least the water-source should have a special guard, and the water should be lifted by use of a metal bucket and light chain reserved for this purpose. The water thus lifted by any of these means should be stored in covered barrels provided with taps, or still better, in cube tanks provided with taps. On no account should the promiscuous plunging of vessels into water-supplies by persons in camps and hospitals be permitted. At the same time, every facility for the observance of caste sentiments should be afforded by the employment of caste natives, wherever handling of vessels, &c., is unavoidable. In towns having public water-supplies, the extension to hospitals and camps of the supply by means of a temporary line of pipes is advisable.

### **Latrines in Camps and Hospitals.**

38. In camps, one latrine should be provided for every block. If time permits, the surface should be made impervious. If this is not feasible and earthen flooring is unavoidable, it should be burnt over daily, and the earth should be renewed at intervals. In hospital and suspect camps, all excreta should be received in impervious vessels, in which disinfectants are ready placed.

### **General Sanitary Precautions.**

40. When disinfection of a person is to be effected, all clothing should be removed in a shed protected from public view. If women are treated, a female attendant only should be present. Any

useless rags should be burnt. The clothing should be removed and be plunged into a wooden tub containing a solution (1—1,000) of perchloride of mercury, and be allowed to soak for 30 minutes. It should then be removed, washed in the ordinary manner, and dried in the sun with free exposure to the air. Suitable clothing for temporary use should be provided. When the disinfected clothing is ready for use, the whole body should be carefully cleansed with soapnut; but preferably, soft soap should be employed. If the latter be used, it should be explained to the person that soft soap is made from vegetable oils, but its use should not be insisted on. Except as to method of disinfection of clothing, as to which special rules have been issued, the same procedure should be pursued at stations where disinfection by steam is practised.

41. The treatment of a person before admission to the health camp shall be as laid down in paragraph 40. But, in the case of the suspect, the persons may be required to throw over the body, after careful cleansing, a solution of phenyle in the proportion 1—100. A bath of plain water may be used subsequently.

42. Bathing of patients admitted to hospital should be conducted only under orders of the medical officer responsible. The method of disposal and disinfection of clothing just described will, however, be applicable.

### **Camp Staffs.**

43. Subordinate Superintendents of camps should be appointed as held requisite by the officer responsible. No subordinate charge should be for a larger population than 1,000.

### **Conservancy Staff.**

44. One toti of each sex and one sweeper should be appointed for every 300 inmates of the suspect and health camps. For every 12 servants of the menial conservancy staff, one peon should be employed.

### **Conservancy Arrangements.**

45. At each camp and hospital, an incinerator should be made. Any native mason who has seen a country "chunam kiln" will be able to make an incinerator of mud and brick or stone, sufficiently well for the purpose. They should be circular structures 4 feet in internal diameter at the bottom and 3 feet at the top.\* Openings should be left at the bottom for vents. In these, all rubbish, rags, and other destructible matter collected from the camp site should be burnt daily. If the plague hospital is attached to a large town, it is well to obtain a field "Silchar incinerator." If such an incinerator is

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\* In rainy weather these can be provided with corrugated iron covers with protected smoke vents.

possessed, all excreta from the suspect camp and hospital should be burnt in it.\*

46. All excreta from the hospital and suspect camp having been received on disinfectants should be buried in pits not less than 5 feet deep in a locality well removed from habitations and water-supplies. Excreta from the health camp should be treated in trenches of the ordinary breadth and depth, that is, not exceeding 18 inches, but quick lime should be added freely to the trench contents.

47. Care should be taken to see that no slops are thrown on the ground in any camp. In the suspect camp and plague hospital, all waste water other than that from the kitchen should be received in open tarred dhobie tubs, in which disinfectants are already placed. Their contents should be removed at regular intervals to trenches at a suitable distance from the camp. In the case of the health camp, the inhabitants should be required to transport all slops to trenches, specially prepared for the purpose. [Part II., page 134.]

#### Bazaars.

48. Arrangements should be made in the proximity of each camp for the maintenance of bazaars. Only dealers having the written authority of the officer in charge of the camp should be permitted to ply their trade. It should be seen that these persons are not inhabitants of affected villages. If the number of persons segregated is not so large as to demand the opening of a special bazaar, the officer in charge should make such arrangements compatible with sanitary requirements as will prevent inconvenience to the inmates.

#### Precautions in Hospitals.

49. Bottles of lysol or phenyle, and solution of perchloride of mercury should always be placed beside conveniently arranged basins for the washing of the hands of medical officers, nurses and attendants, respectively. It is better not to dry the hands with towels after disinfection.

50. All excretions and secretions and rags soiled with them should be received into vessels already containing disinfectants. Promiscuous spitting in the wards should be specially prohibited—all sputa should be carefully received into small tarred *mullays* or earthen receptacles having disinfectants in them. Soiled mats should be burnt; soiled clothing should be steeped in perchloride solution directly it is removed from hospital. Soiled patches of flooring should be disinfected with perchloride solution, and be replaced by fresh material.

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\* *Vide* G.O., No. 487-P., dated 17th May, 1898; and G.O., No. 636-P., dated 2nd July, 1898.



51. Clothes used during duty in wards and disinfection should be exposed to sun action, as soon as the person has fulfilled duty. Before washing, they should be soaked in perchloride of mercury solution. Menial servants in wards and disinfectors should be provided with shoes during work."

### Caste Hospitals.

In some localities—chiefly in towns—there will be found persons who object to enter a hospital built by Government, on the usually incorrect grounds that caste is not sufficiently recognized there. Hence, it is advisable that hospitals that shall provide for caste and gosha prejudices should be ready, before the advent of plague. It would of course be out of the question for Government to attempt to make a hospital for each caste ; hence, it affords aid to the extent of giving half the cost of equipment and of staff for such hospitals erected in situations, and under such sanitary control, as may be approved. Beyond exercising necessary sanitary care of infective matter in such places, no interference is made by Government officials. The full rules as to these hospitals will be found in Plague Commissioner's Proceedings, No. 220A, dated 10th December, 1898. These have been communicated to all Collectors ; so that it is possible to obtain a copy in each district. To permit of easy consultation, however, the engineering description of the buildings prepared by the Department of the Sanitary Engineer to Government will be found in Part II., page 135.

Having regard to the slow method of spread of plague until it has obtained a complete hold of an inhabited area, it is advisable in large towns, where it is understood that several castes require accommodation, for the inhabitants to form a committee, who should be charged with the erection of a Central Caste Hospital to receive first cases. Small hospitals in special divisions of the town should be erected later on, as it is found those areas are attacked. This course should not preclude all reasonable preparations being made, as to choice of sites, capabilities of

water-supply, the whereabouts of staffs and the like. An endeavour to erect buildings broadcast through a town for caste hospital purposes before the area they are intended to serve is attacked, is wasteful of money, labour, and efficiency. Permanent buildings can be made suitable for caste plague hospitals if arrangements for complete ventilation, drainage, and care of floors be exercised; but, wherever open sites are obtainable, it is far better for the patients and staffs that temporary buildings, of the type described in the Proceedings mentioned above, should be utilized.\*

### The Formation of Family Health Camps.

It is at times found that the formation of compact, and therefore readily supervised, public camps of the nature described in the extract above quoted, is inapplicable, for various reasons. Hence, at times, in rural areas, each family is allowed to proceed to its own fields, and there encamp. In this case, they should be required to state in what place they intend to encamp, and obtain the approval thereto of the Plague Officer. Before proceeding to camp, complete disinfection should be demanded of persons, clothing, and property; otherwise, the continuance of attacks whilst in camp must be anticipated. The result of this method is to scatter the people over great distances, and to lead to their visiting other villages in the neighbourhood for their supplies and labour. Hence, it is necessary to organize a complete system of inspection of each group in the fields. Care should be taken by the Sanitary Inspector and the Camp Superintendents detailed for duty, to make the people distinctly understand that so long as they remain in the fields, and resort only to a special bazaar, which should be arranged for their benefit by the Plague Officer near the infected town (or near the Government Health Camp, if one be formed) they will in no way be interfered with. Should an attack

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\* It may be added that the type of buildings would suit all public or private plague hospitals, and need not therefore be regarded as solely reserved for Caste Hospitals.

occur amongst these people, it would be the duty of the Sanitary Inspector to effect disinfection of the clothing of all contacts, and advise that the sick person with his attendants be segregated, and removed to a clean site a few yards from the spot in which the person attacked resided. Throughout, care in management so as not to frighten the people and thus cause them to scatter, must be the leading feature in the Sanitary Inspector's methods.

The number of persons in each group should be registered, and the whereabouts and state of health of each individual should be definitely ascertained by the Sanitary Inspector, on each occasion of his visits of inspection.

A good way of aiding the finding the locality of these petty camps when scattered over a large area, and hidden in the midst of jowari crops, is to erect a tall bamboo with a bit of red cloth attached to mark each camp. Attached to the pole should be a painted board showing the register number of the group. On this also should be written in chalk the number composing the groups, as men, women and children.

The Village Headmen of neighbouring villages should be warned that persons have left the infected village, and are encamped in their fields on account of plague; otherwise, as has actually happened, where the village fields adjoin, the ordinary social intercourse occurs during hours of field labour, with the result of spread of infection.

A timely warning sent to the neighbouring villages should secure their co-operation in preventing strangers entering, or, at least, the enforcement of the passport system, and consequent retention under observation of those that stray from these camps.

### Sanitary Precautions in Family Camps.

In the treatment of the sick, necessarily, all the precautions alluded to under "home segregation" should be observed as far as feasible, in respect to clothing, destruction of rubbish and of infective matter, &c., &c. In the matter of water-supply arrangements, to prevent persons from an infected camp using wells or tanks in common



with others efforts should be made, by causing them to be supplied by healthy neighbours of the same caste at the source. Where family camps are collected in close proximity so as to form large groups, it may be necessary to arrange for the opening of new wells, and for protecting old supplies from contamination by mechanical means (see Part II., page 113). For conservancy, scavengers should be appointed in accordance with rule 44 quoted under "suspect camps." In their absence or, if the number available be too few to work the "trench system," nothing could be more satisfactory than the Jewish conservancy system described in Part II., pages 109—126.

### Guarding the Evacuated Area.

The Plague Officer will arrange for the retention of a guard over the evacuated area, for the purpose of preventing persons in Health Camps returning to it—lest they again become infected—and also with the object of preventing stealth of property that may be unremoved.

### Disposal of the Dead.

The most satisfactory manner of disposing of plague corpses is by cremation. This mode of course must not be employed in the case of Mahomedans, and but few Christians would care to sanction it—although there is nothing in the religion of the latter to interdict this sensible process. Certain caste of Hindus also object to cremation. Such prejudices must be respected.

Burial should take place at spots remote from water sources and dwellings. The subsoil water of the graveyard should not flow in the direction from which the inhabitants of any closely neighbouring area derive their water-supply. The subsoil water should be, if feasible, not less than three feet below the level at which the body is placed. The soil should be of a porous nature; hence, clay is particularly objectionable. It is usual to demand that the body be buried at a depth of six feet. There is no reason, however, to think this is imperative, where difficulty in

securing suitable sites is experienced. Quicklime may be employed where burial is at a depth of less than five feet ; but should not be used for Mahomedan corpses.

The place in the premises where the body has been washed should be identified, and the direction in which the flow has occurred should be traced. The perchloride of mercury solution should be freely distributed over all stained parts, and both private and street drains, if they have received the washings, should be flushed with it. It is well to place below the anus of the corpse a small cloth pad filled with carbolic sawdust, so as to catch any oozings from the bowels during the transport of the body. The whole of the cloths surrounding the body should be soaked with the perchloride solution, without the addition of the aniline dye. No objection is likely to be made to these reasonable precautions ; but it is the duty of the Sanitary Inspector, should he find objection made by those responsible for the corpse, not to enforce obedience without consulting the Plague Officer in the matter.

Cremation should be conducted in the usual manner ; but care should be taken to see that the bier and all rags and ornaments are burnt, instead of allowing them, as is frequently the case, to be left strewn over the ground. On no account should those who render service in the cremation grounds be allowed to remove, for their own use, any of the articles or cloths employed in connection with the bier or corpse.

Bathing of funeral parties should not be allowed in tanks and rivers, but should be conducted in a spot where the water can be received on ground well exposed to the sun. This spot should be disinfected, subsequent to the bathing process, with perchloride of mercury solution. Persons who have performed offices connected with washing and preparing the dead must be regarded as " contacts " and, after disinfection of their persons and clothing, they must be observed in the " suspect " camp, or under such rules, giving greater liberty as may be in force, under the Plague Officer concerned.

## Disinfection Staff.

In the preceding paragraphs, it has been insisted that the correct sanitary action is to evacuate indigenously affected areas. Not only does this action give the opportunity for persons to escape contact with infection, but it also affords the public authorities the power to place the dwellings in such a sanitary condition as may enable contagion to be combated with better chances of success. Hence, arrangements are made directly an area is evacuated to disinfect and cleanse *each* house within it.

If the houses where actual cases of plague have occurred have not been disinfected as a part of the treatment of imported cases, this should now be proceeded with.

The staff to accomplish this duty may be coolies obtained in the infected village, or sepoys. The latter will be commanded by their own officers. In the former case, the Sanitary Inspector will supervise the work; in the latter, he will advise as to methods to be pursued. The use of sepoys is at all times preferable, as work under their care is conducted with greater exactitude.

Whether the disinfecting staff be formed of coolies or sepoys, certain details must be regarded, with reference to the care of their persons, organization, and mode of working. In the case of coolies, it may be more difficult than with sepoys to exact obedience: still it can be secured. No attempt is made to distinguish treatment of the two classes. The same principles, if not the identical rules applicable to the sepoys, should apply to the coolies:

- (1) Provided time be available before proceeding to an affected area, all members of the staff should be inoculated with haffkinine; if not, they should be inoculated group by group, so as to prevent all being absent from work at the same time.
- (2) They should be lodged in huts or tents beyond the infected area, and be kept together as a disciplined body at all times. Failing this being



possible (and it is not likely to be impossible anywhere if fair wages be offered for the work done) in the case of coolies, they should be allowed to proceed home; but their places of residence should be carefully ascertained, and should any one of them not make his appearance at any muster, his whereabouts should at once be searched for. Under no circumstances, should leave be given without it being ascertained, by a full examination of the man applying for it, that he is suffering from no symptoms likely to accompany plague.

- (3) Disinfectors should have one, and, preferably, two suits of clothes to be used solely whilst on duty. Where sepoys are employed, these suits should be of common white drill, and should embrace a jacket without ornamental folds, puggree, trousers, boots, and putties. In the case of coolies, if boots and putties are not forthcoming for economical reasons, at least shoes (not sandals) should be allowed them at public expense. Shoes for this purpose are required to be part of the ambulance staff equipment, (page 24.)
- (4) Disinfectors should be paraded before going to work in the morning; their hands, feet, and all exposed parts of the body, should be carefully observed for abrasions and cuts. In instances where these exist, the man should not be allowed to go to work. During this inspection, it should be ascertained if any man is suffering from any form of illness. Any grade of fever should disqualify for work for the day. Symptoms of plague should be watched for, and early segregation be effected. This form of inspection should be repeated on return from work before breakfast in the morning, and, again, on final return in the evening.

(5) Disinfectors should be divided in sections of ten ; one hundred men should constitute a full company. Over each ten men should be appointed a Section Commander.\* This man should be distinguished by a special mark ; such as a red band round the left arm.

(6) For each section should be allowed one cart to be drawn by hand. Upon this cart should be the full sanitary equipment requisite for disinfection purposes. This may be taken as follows :—

6 mumooties, 4 pickaxes, 2 crowbars, 2 axes, 2 shovels, 20 yards rope, 1 ladder 20 feet, 24 gallon tubs, 1 wooden 3-gallon bucket, 3 zinc buckets, 2 Chinese pumps, 6 earthen chatties, 1 copper “ deksha,” 2 kerosine oil lanterns, 2 small and 2 large paint brushes, one 20 oz. measure glass, one 2 pint tin pot, 2 balls of twine (country), 1 jack knife, 2 lb. red paint, 2 lb. black paint, 12 whitewashing brushes, 2 stencil plates for figures up to 10, 50 lb. sawdust, 5 lb. carbolic acid, 2 lb. perchloride of mercury, 4 lb. hydrochloric acid, 2 lb. strong sulphuric acid, 4 lb. phenyle, 10 oz. aniline blue dye, 8 oz. permanganate of potash, 2 lb. soft soap, 1 stretcher (for every five sections). Quicklime as required.

(7) Each cart and each separate part of equipment should be painted in red, with the number of the section to which it belongs.

(8) Each Section Commander should be responsible for the good order and safety of the equipment of his section.

(9) Over each fifty men should be appointed a Superior Officer, accustomed to command.

(10) A section will usually suffice for the cleansing and disinfecting of one house ; hence, as far as possible, all sections should have distinct work assigned to them. All orders concerning methods

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\* Where coolies are employed, the term “ Maistry ” would be more appropriate.

to be employed should be communicated to Section Commanders.

- (11) Before proceeding to work, the Officer in charge should inspect all equipment, and see that it is complete and sufficient for the day's work. Orderly loading should be insisted upon. All heavy articles and those least likely to break should be placed at the bottom of the cart; those fragile above these.

On returning from work, the carts should be neatly drawn up in a place assigned to them. Such articles as degenerate from exposure to weather, such as quicklime, should be stored under shelter. The remaining articles may be left in the carts.

- (12) At a point not exceeding 100 yards from the disinfectors' camp, should be assigned a place for the disinfection of their clothing and bodies. For each section should be dug a pit of say three feet depth, and 2 feet 6 inches square. To the front of the pit should be placed a wooden tub or earthen receptacle, containing a solution of perchloride of mercury 1—1,000. By its side, the Section Commander should take his post. To his right the section should sit down, and take off their boots and putties. Marching round one side of the pit the men should successively hold their boots in front of the Section Commander, who should then pour over the outside the perchloride solution, taking care that the drippings fall into the pit. After presenting the boots, the men should hold out their hands, over which, again, the solution should be poured. If the boots have leaked, or if the feet appear dusty the solution should be poured over the feet also. The boots should then be placed upon



the ground at an appointed spot, with the soles exposed to the sun. The clothing should then be removed, and be hung up on ropes, so as to fully expose it to the sun. The Section Commander should, after the Section has passed him, proceed to disinfect the spot where the men have removed their boots, by perchloride solution. The men should then bathe, and be required to put on clean suits of clothes—kept solely for use off disinfection duty. These processes should be repeated each time they return from work, before being dismissed from duty or allowed to eat food. The disinfection suit should not be kept in the tents or huts in which men sleep; a separate shelter should be devoted to the storage of such clothing at night. It should be assumed only immediately before assembly for duty.

- (13) If it can be arranged, each Section should reside in its own hut: the number of the Section should be posted outside on a board.
- (14) Section Commanders should be taught how to mix the required disinfectants. The Officer in charge of the whole party should be responsible for the custody and provision of disinfectants, and should invariably be present when the disinfecting solutions are made.

### Preparing for Disinfection.

- (15) Whatever the nature of the work, each section should daily bring its cart with it, so that there be no difficulty, by alteration of programme, when on the spot.
- (16) The Officer in charge of disinfection should take each Section Commander, and point out to him the work to be fulfilled, and give him personal instructions as to any departure required from ordinary arrangements.

- (17) The Section Commander, having received his orders, should have his cart brought as close to the house to be disinfected as convenient. Sick persons may have to be removed ; in this case the Medical Officer, or Plague Officer, will issue instructions to the Section Commander. If the person to be removed is a female, the Plague, or Medical, Officer, will make arrangements to use the nurse attached to the ambulance staff.
- (18) For effecting transport, a stretcher or, failing this, a charpoy, or other temporary structure, should be taken close to the patient, by two men told off by the Section Commander.
- (19) The patient having been re-assured by kind words should be gently lifted, so as on no account to bring the body to an approach to a sitting or standing posture ; that is, during the lifting, the body must be kept horizontal. One man having taken charge of the feet, one of the shoulders and head of the patient, the Section Commander should grasp the patient firmly by the hips, by passing a hand on either side. He should then give the word " lift ", when, by a simultaneous movement by the three persons engaged, the patient may be gently placed on the stretcher. Whilst this is being effected, the person holding the head should take care that the patient does not cough in his face.
- (20) Trustworthy men should then be detailed to escort the patient with the relatives \* who wish to nurse

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\* The officer in charge should take care that every member of the plague staff is fully aware of the rules relating to Plague Hospitals, namely, that caste is fully observed to the extent of permitting the patient to have food prepared by his own relations ; that his own relations may nurse him ; that no English medicine or treatment need be accepted ; that, in short, beyond seeing to the sanitary care of infective matter, no interference is made with the private wishes of a patient in a Plague Hospital.

him to the plague hospital, and the "contacts" to the segregation camp. The man responsible should, in each case, obtain a receipt from the officer in whose charge he has delivered the persons. This should be handed to the Section Commander in charge of the party, who would hand it to the officer responsible. Whether or not contacts should be segregated will, of course, depend upon the opinion of the Plague Officer. All who have inoculation certificates can, under Mofussil Regulation 31, claim exemption from segregation, but they can be subjected to domiciliary observation.\*

### The Disinfection of Houses.

The inhabitants should be warned that where money, or jewels, or other property are concerned, the Tahsildar or Plague Officer, if they so wish, will make arrangements for their safe keeping. They should also be informed that should, during disinfection, any serious damage be done, compensation will be promptly paid. These matters having been seen to, and all inhabitants having vacated the house, its disinfection should be proceeded with. The disinfectants to be employed are:—

### Disinfectants.

The standard perchloride solution is prepared as follows:—

Perchloride of mercury	...	oz.	$\frac{1}{2}$
Hydrochloric acid	...	„	1
Aniline blue dye	...	grs.	5
Water	...	gals.	3

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\* As inoculation, although very largely diminishing the attack rate and protecting greatly from death, does not confer complete immunity, there can be no doubt of the sanitary importance of maintaining the inoculated "contacts" under the surveillance system, so that their condition can be ascertained *daily*.



This gives a strength of 1—1,000. Various methods are employed for conveniently distributing this solution, and, consequently, all sorts of rules are quoted. If, however, the solid perchloride be duly made into powder, and be given to the officer in charge in packets of waterproof cloth, or small wooden boxes, each sufficient for 24 gallons (that is 4 oz. packets) placed in a large bamboo with tight-fitting cover, all requirements will be subserved; provided very ordinary care is taken to see that the perchloride is really dissolved, and not sunk at the bottom of the vessel. To each 24 gallons should be added 8 oz. of the hydrochloric acid. The hydrochloric acid should be measured in an ordinary glass measure. The bottle of acid should be packed in a tin with sawdust surrounding it, so that if breakage occur no harm need follow. The great point in this matter is not so much securing concentrated solutions as making sure that the correct proportion of water is added. This can only be obtained by giving the most strict orders, and by *the Officer in charge daily personally* supervising the making of the solution.

A bucket that will contain three gallons of water should be selected, or if those employed be larger, a red paint mark should be made in the interior, showing up to what point the contents would measure three gallons. This bucket, which may be of zinc, should be marked "Std. 3 gals." (Standard three gallons) in red paint on the outside. Under no circumstances should the Section Commander allow this vessel to be used for any other purpose than as a measure. There should also be equally rigidly set aside for the special purpose a wooden tub (a half cask). Such casks are usually between 24 and 25 gallons capacity. It would therefore be suitable to place, in red paint, a mark at the 24-gallon level inside the cask, and, outside, to mark "Std. 24 gals."

In proceeding to make the mixture, the 24-gallon tub should be first filled. The acid should then be put in a

small quantity of the measured water in an earthen chatty, or wooden bucket ; to this should be added the perchloride of mercury finely powdered. The whole should then be well stirred with a wooden stick, and, with additions of water, should be gradually mixed with the contents of the tub ; the aniline dye (grs. 20) should then be added, and be well stirred till dissolved.

Every 1 oz. of the perchloride of mercury dissolved so as to make a solution of 1—1,000 should suffice for the disinfection of 2,000 square feet of surface to which it is applied. In regard to this calculation, however, it must be regarded solely as a rough guide. There should be no stinginess in the amount of solution issued. The desire for economy sometimes results in the disinfecting parties receiving daily allowances, without the slightest regard to the number of square feet to be disinfected. If disinfection is to be of any use at all, it must be thorough ; although, of course, careless waste must be prevented. The aniline dye is added to this solution to prevent persons mistaking the otherwise colourless and very poisonous solution for plain water. The addition of the hydrochloric acid is found necessary to prevent the tendency of the perchloride of mercury to combine with the albuminous portion of the organic matter it may be brought in contact with ; it should never, therefore, be omitted, and is to be much preferred to solutions of perchloride of mercury with salt, as frequently advised.

In mixing this solution, no vessel, ladle, or other articles formed of metal should be employed, as corrosion of the metal surfaces ensue, and, as the result of this action is to remove the perchloride of mercury from the solution, the disinfectant action is lost.

*Sulphuric acid solution.*—This should be made of a strength of 3 oz. of the acid to 4 gal. of the water (1—250), as advised by Mr. Hankin, as a result of numerous experiments by him. A second tub should be kept for the

purpose of making the mixture; but the same three-gallon bucket will suffice for securing the necessary amount of water, if by making a second mark on it be represented one gallon, or one-third of the total bucket. This added to the full bucket measurement will give the four gallons. The sulphuric acid should be packed for transport, as in the case of hydrochloric acid. The acid should be the strong commercial sulphuric acid, and should be so labelled. To prevent the acid solution being mistaken for water, phenyle should be added in sufficient quantity to make it milky and of a tarry odour.

The perchloride solution should be used for disinfecting all walls, floors, wooden furniture and clothing. Its distribution should be arranged by means of earthen chatties and "Chinese pumps"—the former being employed when simple pouring is required such as over furniture and floors, and the latter where it is necessary to force the solution to a height as in the case of the walls.

The "Equifex Spray Producer," which is possessed by most of the Madras Municipalities, distributes the solution in so fine a spray that it is more likely to reach the cracks and crevices of walls than the coarse spray produced by the Chinese pumps. But the work is accomplished so slowly by this means that, although excellent for ordinary epidemic purposes, it would be impossible to undertake the vast amount of work required during plague. Where, however, only a few houses have to be dealt with, Equifex Sprayers should be preferred. The Chinese pump has a disadvantage of affording very hard work to the disinfectors. The motion of pumping is both arduous and monotonous, and is liable therefore to be neglected. To get over this difficulty Messrs. Sultan and Company, Royapettah, Madras, have made, on the author's design, a "portable gravitation disinfecter." By this means a bucket containing 24 gallons can be elevated to a height of 20 feet. Attached to the bucket is a flexible canvas hose 120 feet or more in length,



supplied with a nozzle and spray. The machine can be kept outside the street or put in the backyard of the house to be disinfected. A powerful spray of the solution or a continuous stream, up to a height of about 18 feet, can be produced steadily at will, after lifting the bucket to the necessary height. This whole arrangement is readily managed by two, or at the most, three men.

The sulphuric acid solution should be reserved entirely for instances where non-calcareous mud has to be dealt with, such as the filthy and organically polluted slimy mud found immediately adjacent to dwellings in court-yards, and in the earthen floors of latrines. Distribution should be accomplished direct from chatties.

Carbolic saw-dust should be made by measuring in any convenient vessels, such as a small tin pot, one part of the acid to nine parts of saw-dust. The carbolic acid and the saw-dust should be mixed gradually, so as to secure an uniform mixture. As soon as made, it should be put into a kerosine tin having a tightly fitting cover. This material may be used for temporarily covering vomit, excreta, urine, sputa, rats, etc., before removal for burning.

### Process of Disinfection.

All the preparations have been made ready, and placed in convenient situations where they can be obtained by the disinfectors, the Section Commander with a couple of disinfectors should proceed inside the house, and open up fully all the doors, windows, or other openings, so as to admit freely light and air.

It is rarely that a house belonging to the lower orders can be found where the arrangements for light and air are sufficient. Hence, it is necessary to make temporary openings. Where the roofs are tiled, this can be easily accomplished by removing the tiles. Inside the house, immediately below the parts of the roof that are to be opened, the floor should be soaked with perchloride solution

so as to receive the possibly infected dust. Disinfectors should then be placed on the roof, and an opening of the size required should be made by lifting the tiles, which should be handed to the ground carefully so as not to break them. Where the roof is flat and earthen, as found in the Deccan Districts, the opening should be made by the pick-axe and mammaty; perchloride solution should be thrown on the place that is to receive the earth. The removed earth should then be put on the roof, at the side of the opening and be well exposed to the sun's action, as rats may have infected it. This opening of the roof should be supplemented, when the walls are sufficiently stable, by openings in the side walls, so as to imitate the function of windows. As to the extent and number of these openings, the officer in charge will give directions and, to prevent mistakes, the limits should be marked in his presence with lime-wash. They should suffice to give free entrance to the direct rays of the sun and of the wind into each room. Three square feet in each case might be regarded as a minimum.

Both air and light having thus had an opportunity of entering as freely as possible, a space in the front of the house should be soaked with perchloride solution. Two or more disinfectors should be told off to remove the property in the house. As it is brought from the house, it should be placed in four heaps on the soaked space, in accordance with the instructions of the Section Commander—subject to final orders by the Plague Officer. In one heap, should be placed articles regarded as worthless and destructible, and indestructible articles of no value; in the second heap, should be placed indestructible articles that can be purified by heat, such as metal cooking and eating vessels; in the third, should be placed articles that can be purified by boiling, or soaking with perchloride solution; and, in the fourth, all valuable articles such as silk cloths and the like that would be damaged by boiling. In removing articles from the house, care should be taken to raise as little dust

as possible ; that is, there should be no such thing as "chucking" clothes, etc., from the house basement to the ground ; they should be placed there gently. Articles should be removed with as little direct handling as possible ; dirty clothing may conveniently be moved by shovels or long bamboos. Suspiciously foul articles should be soaked with perchloride before removal. In the case of rats found dead of plague, this precaution of not handling them and soaking with perchloride should always be pursued, as, according to Dr. Simond, rats are infested with fleas that may transfer themselves, and infect man. The rubbish in the backyard and surroundings of the house should now be carefully collected and burnt ; so that the whole interior of the house and its surroundings is absolutely clean. In collecting rubbish, no general sweeping should be employed, as dust might be raised unnecessarily.

The whole flooring of the house should then be fully flooded with perchloride solution. In dark rooms with cow-dung floors, the strength of the solution may be doubled (1—500). Where slimy mud is encountered, as in gutters and latrines, the sulphuric acid solution should be used.

The Chinese pumps or the "gravitation disinfector" should then be worked, so as to cause the whole interior of the walls of the houses to be thoroughly saturated. It is no use, either in the case of the floor or walls, to do a bit here and there ; the process must be so complete that not a crack, crevice, or corner, has been neglected. Neither should the roof be neglected ; if it be of the flat earthen type supported by numerous wooden rafters and bamboo matting, it is better that the wooden portions should be exposed by removal of the earthen part of the roof, so that the wooden rafters should be thoroughly soured with perchloride solution. The earth from the roof should then be exposed to the sun, by spreading it out. In houses where dead rats are found, if the earth from the roof be a manageable quantity, it might be burnt by Col. Lawrie's "Kiln



method.” (Page 95.) In the earth of flat-roofed houses, rats find a more congenial home than in earthen floors; they also find residence below tiles not incompatible with comfort—especially if the floors happen to be of material not easily burrowed. According to Professor Lustig, both the urine and fæces of plague-infected rats contain the microbe. It is obvious, therefore, more especially with reference to recrudescence of the disease, that the utility of treating the floor and walls of the house is much minimized if the roof be neglected. As, however, official opinion is against this course, the Sanitary Inspector will usually be required to confine his attention to the floor and the walls, and such orders must be obeyed. It, however, occasionally happens that houses and huts are of so little value that it is a cheap and decidedly effectual course to fill the inside with combustible material and burn the roof down. No such action should be taken by a Sanitary Inspector without the full approval of the Plague Officer, and then only after making certain surrounding houses and property will not be endangered by spread of the flames.

### Disinfection of Articles.

Whilst disinfection of the house is proceeding, a fire should be made outside. On it should be placed all metal and unglazed earthen articles, till too hot to hold. The unglazed earthen vessels may then be broken. The metal vessels may be regarded as purified. All worthless destructible articles—special care being taken to collect all rags—should then be thrown in the fire and burnt. Articles of clothing that will not be injured by subjection to wet should be soaked in perchloride solution, for half an hour. These should then be transferred to earthen or metal vessels, and be boiled for a further half an hour. After being dried in the sun, they may be regarded as safe.

In the case of valuable clothing, if there be no manner of doubt it has not been in contact, or in the same room,

with a plague patient, it may be regarded as sufficiently disinfected by exposure to sun for three days during not less than four hours each day—care being taken to completely expose all surfaces, and to turn the cloth from time to time. If there be any doubt on the subject, it should be destroyed unless, should a steam disinfecting machine be at hand, the owner prefers to let it run the risk of slight degeneration by subjecting it to treatment in it.

Grain in bulk forms a constant portion of the valuables in mofussal native houses. Where it is in small quantity exposed for daily use, and there is suspicion of contamination by rats, it should be destroyed by fire. Where the quantity is large, and has not been exposed, that is, it has been retained in the usual basket, which is specially made to prevent entrance of rats and moisture—it should be removed and exposed to the direct rays of the sun, by spreading it out in thin layers. Mr. Hankin has shown that there is a tendency for the plague microbe to die on grain, but that the period of survival varied according to conditions from a few hours up to thirteen days.

### Care of Disinfectors during Work.

Should at any time a disinfecter receive an abrasion or wound, he should be at once required to wash the part in the perchloride solution, and should desist from work. On no account should disinfectors enter a house without shoes and putties. They should be warned to work quietly and systematically. No dust should be raised, and, if this be unavoidable, perchloride solution should be placed on the place or articles to be treated.

### The identification of Houses.

If *plague* has occurred in a house, the wall at the side of the main door should be marked with a plain horizontal mark 18 inches (one cubit) long and four inches broad (one hand breadth) in *black paint*. Directly above the line

should be painted, in figures, the date, and below the number of attacks. A line of the same measurement *in red paint* and with the date above should be made directly over the black line, showing the date of *disinfection*.

### Drains, Etc.

After disinfection of the house is complete, and all articles have been satisfactorily treated, attention should be turned to the gutters, drains, or cess-pools, which have received the sullage water of the house, and to filth or rubbish accumulated near the premises. Cess-pool contents should be thoroughly disinfected by sulphuric acid, by ascertaining the contents in gallons, and adding it in the proportion of three ounces to every four gallons (Hankin). The drain should be flushed with the solution of the perchloride of mercury of double strength (1—500). Stained surfaces should be treated with perchloride of mercury solution 1—1,000, or with 1—250 sulphuric acid solution, according as it may be considered the mud is easily penetrable or not. All rubbish and rags from the gutters and the vicinity of the houses should be collected and burnt. If any of the household sweepings have been put in the public dust-bin, the contents should be burnt—preferably in the bin so as to heat it thoroughly.

### After-Treatment of Houses.

Beyond making arrangements, such as placing a bar across the door opening, the house should be left unclosed; so that wind and sun action may be fully secured. In houses with earthen floors, the Government of Madras has directed that Colonel Lawrie's "kiln method" should be employed. This can be best adopted by allowing time for the flooring to become completely dry, after the treatment above described with perchloride of mercury solution. The method has the unavoidable disadvantage of causing the earth, if still in an infective state—notwithstanding its recent disinfection by perchloride of mercury—to be much



handled by the disinfectors. The plan would probably be of much utility if confined to treatment of known infected patches in dwellings, instead of, as customary, using it indiscriminately for infected and suspected houses alike—as examination of heaps in actual routine practice shows that to be effective care is requisite. Omitting the preliminary treatment of the flooring by whitewash, the following is the description given by Mr. Stevens, Deputy Plague Commissioner, Hyderabad :—

“The kiln should be made in any sufficiently large-sized courtyard, garden, or open space in or near the house, or the road or pathway immediately facing the front entrance of the house can be used. A circular kiln will be found the most convenient in shape. The floor of the kiln is made of two layers of ‘oopies,’ four inches deep, laid flat and packed closely together. The mud floor of the infected house should be carefully dug out to the depth of  $1\frac{1}{2}$  inches from every room, verandah and yard which has been whitewashed, and filled into iron baskets, or empty kerosine oil tins, if possible without spilling or raising any dust. The dug-out earth should now be carried to the kiln and evenly spread over the ‘oopies,’ which from the floor of the kiln, to a depth of  $1\frac{1}{2}$  inches. This, the first layer of infected earth, is then completely covered with a layer of ‘oopies,’ 2 inches deep, upon which a second layer of earth is spread and covered with ‘oopies,’ then a third layer of infected earth, and so on with alternate layers of infected earth and ‘oopies,’ until the kiln is complete. One and-a-half to two feet is the best height for a kiln. Lastly, the kiln is covered in from top to bottom with two layers of ‘oopies.’ It should then be fired at the base and allowed to slowly burn itself out—a process that usually takes about 48 hours. It is, however, advisable not to disturb the ashes of the burnt kiln for a week, as it continues to smoulder for about that time. When the kiln has cooled down, it should be opened in one or two places and examined, and if found completely burnt

out, the ashes should be removed to cultivated lands and used for manure."

After the completion of the "kila method," and the replacing of the burnt flooring by new material brought from a cleanly place, the whole house is sometimes white-washed. This can be of little service as a disinfectant, if the perchloride of mercury solution has been of any use; but it is desirable at times to leave houses that have been treated in a cleanly and neat condition. The whitewashing of the walls will accomplish this. The lime used should not be "stale," but "quick."

Theoretically, a house that has been purified by disinfection should be safe for re-occupation, provided it is not within an indigenously affected area, and, therefore, liable to be re-infected by rats that are known to be still suffering from the disease, as soon as it is thoroughly dry.

### Steam Disinfection.

In treating the effects of large communities, it would be impossible to overtake the work of disinfection of clothing efficiently, by means of boiling and of soaking in perchloride of mercury solution. Subjection to heat by means of steam forms a convenient method for treating rapidly large quantities of clothing. Various mechanical contrivances are employed for attaining this end. The most simple use of "current steam" is illustrated by a rough apparatus used in Russia, during the epidemic of cholera, in 1892 (Clemow):—

"On the top of an ordinary kitchen or washing boiler [a large "deksha," such as used for dhobies, would suffice] is placed a simply made cask or barrel, which should closely fit by its lower edge to the upper edge of the boiler. In the bottom of the cask are pierced a large number of holes; in its lid, which should fit tightly, are two small holes, in one of which is fitted a cork transmitting a thermometer, the other being a very small one for the exit of the steam.

Inside the barrel are screwed hooks on which to hang the articles to be disinfected. The boiler being heated, steam enters the cask by the holes in the bottom, passes over the articles and escapes by the hole in the lid. The process is continued for an hour after the thermometer marks 100° C." (212° F.)

This rough apparatus might suffice, in a small town, for disinfecting valuable cloths to which it would do very little injury, as an adjunct to other methods for common clothing. It secures that the article shall be subjected to a temperature of 212° F. which (page 3) is more than is necessary to kill the plague microbe. It would be essential that the clothing be well spread out, so as to fully expose all surfaces. But when a large quantity of clothing is to be treated (for instance, "suspicious persons" at Railway Inspection Stations or "contacts" in camps), it must be in the form of bundles, whilst blankets and other thick material have to be dealt with. Experience shows that, under these circumstances, air is so enclosed both in the intervals between the bundles and in the pores of the materials themselves, that heat is not equally conducted throughout the mass. Further, owing to the clothing and surface of the vessel in which the action is conducted being colder than the steam at the first stage of the operation, condensation is apt to occur, and thus the articles suffer from moisture. To meet these various requirements, it is necessary to have an arrangement that shall enable the sides of the containing vessel and the goods to be heated to a certain extent before admission of steam, so that the risk of condensation shall be minimized; secondly, there must exist a method of securing displacement of air from the interstices of the goods, so as to allow effective penetration of the steam; lastly, there must be the power to secure a temperature higher than 212°, as a margin of safety, because at least in reference to the spores of certain disease germs (the plague microbe is, however, so far as is known, sporeless) a higher temperature is advisable. To get a



temperature higher than  $212^{\circ}$ , it is but necessary to place the steam under conditions of pressure. Thus, whilst at atmospheric pressure the temperature of boiling water is  $212^{\circ}$ , at 20 lbs. it is  $228^{\circ}$  and at 30lbs.  $250^{\circ}$ . This can be secured by the use of a steam-tight iron cylinder, provided with a gauge showing the pressure of steam admitted from an adjacent boiler. To meet the difficulty as to condensation, in the best machines provided in the market (the Washington-Lyon) a double jacket is used. By introducing steam between the jacket and the disinfecting cylinder, before passing the steam direct on the goods, the necessary heat is acquired and condensation prevented. The jacket may be employed also for securing super-heated steam; but this is neither a necessary result of the arrangements, nor a desirable part of the process. For exhausting the air, a steam jet can be used, which discharging at great velocity acts on the same principle as an aspirating cowl, by a tube communicating with the interior of the cylinder, so as to cause the air to rush out and produce a vacuum. This effect may also be secured by rapid condensation of the steam by cold water in a vessel attached to the cylinder. As a preliminary to this, displacement can also be aided by passing steam into the cylinder and allowing it to rapidly pass out again. The machines in use at the Railway Inspection Stations in the Madras Presidency (with the exception of that at Hospet) imitate, in a cheap manner, the principle of the Washington-Lyon apparatus without the expense of a double jacket. These were designed by Mr. Moss, Superintendent of the D. P. W. Workshop, Madras.

### Inoculation against Plague.

Providence has by no means launched animals into the world to be the helpless prey of microbes, nor of any other accident that may occur during life. Thus, a gash in the skin is followed by methods of repair, and substitution of tissue, having either exactly the same or closely approximating qualities of that lost. The fractured bone requires

but rest to find a natural cement formed to join once more the severed ends. Similarly, conservative processes are at work against the entrance and overwhelming of the body by disease-producing microbes. When microbes pour forth poison in the body, the living cells oppose their inimical influence by producing bactericidal, or germ-killing, substances; this may proceed to such an extent that the bacteria may be actually killed. In like manner, a modification of the products of the living tissue cells may ensue, which will resist the injurious influence of the excretions or toxins of the microbe. These are known as antitoxins. When these changes have been produced in the body, there follows a state of such fortification against the special microbe concerned that, on its introduction to the body, neither the microbe can multiply, nor the toxins produce their evil influence upon the system. The subject on whose body these processes have been undergone is then described as possessed of "immunity."

Recovery from attacks of measles, small-pox, cholera and typhoid fever give, as is popularly admitted, very great, though not complete, protection against a second attack—a result which is due to the power of resistance acquired by the body in the manner above indicated. Protection of this description—acquired following attacks of the disease concerned—is known as "*natural immunity*." From ancient times, endeavours have been made to procure protection from diseases in the individual by inducing artificially a state of immunity. Thus, in respect to small-pox, the system of inoculation was many centuries back freely used by the Chinese, Arabs, Mahomedans, and Hindus. The person to be protected was inoculated in the skin with the virus from a diseased person. It was hoped by selecting mild cases from which to take the virus, and by operating only on those in a high state of health, that the attack inflicted would also be of a mild type. This was not always the case—severe small-pox causing death being

frequent ; but, so great was the mortality from small-pox in pre-vaccination days, that this risk was gladly accepted by the people, rather than incur the danger of a natural attack of the disease. Indeed, the ignorant of the population of Ganjam still have a leaning towards this operation which, up to recent times, has been practised amongst them by Orissa Brahmins. In England, inoculation was borrowed from the Mahomedans of Constantinople, and was largely used from 1718 to 1796, when the infinitely safer method of vaccination was discovered by Jenner. Unknown to him, this operation seems to have been anticipated by the ancient Hindus, if the following extract described by the author of Ayurveda Vignana is to be credited. According to him, the quotation is derived from Dhanwantari's Sacteya Grantham:—"Take the fluid of the pock on the udder of a cow, or on the arm between the shoulder and elbow of a human subject, on the point of a lancet, and lance with it the arms between the shoulders and elbow until the blood appears ; then, mixing the fluid with the blood, the fever of the small-pox will be produced. The small-pox produced by the fluid from the udder of a cow (*gostany odacum*) will be of the same gentle nature as the original disease, not attended by fever, not requiring medicine," &c., &c., &c. It will be seen from the above that the production of "*artificial immunity*" has been recognized, with reference to small-pox, both by Mahomedans and Hindus for many centuries. It hence stands to reason that in accepting any mode of inoculation that would protect against plague, neither caste, religion, or custom is violated ; the principle of securing artificial immunity, by introduction of modified disease-bearing products, having been fully accepted by the natives of India.

Recognizing the enormous advantages which the modifying of the virulence of the small-pox virus undergoes by passing it through the body of the calf, before introducing it into man, which vaccination implies, the great French



scientist (Pasteur) investigated various methods for decreasing the virulence of disease microbes; and by means of these, or their toxins, inducing artificial immunity in animals. In these methods he acquired much success. By adopting the principles of Pasteur and his followers, Mons. Haffkine obtained a vaccine which has been found to afford much protection against cholera. As soon as plague attacked India, he devoted his attention to obtaining a new vaccine that should protect from this severe disease. In this, he has been eminently successful. The preparation which he has made is known as "Haffkine's prophylactic serum"; probably, in lieu of this long term, it would be more convenient to call the preparation "haffkinine," in honour of the inventor. It is prepared by placing the living microbes in a solution, which experiment has shown is not inimical to their life and will afford them nourishment. Of this solution, unadulterated cow's ghee is an important part, and, as to other constituents, nothing exists which can be objectionable, when injected below the skin for medicinal purposes to either Mahomedans, Hindus or Jews. In this nourishing mixture placed in a glass vessel, and kept in a dark place at a suitable temperature, the microbes increase, and throw out their toxins until, at the end of six weeks, they have exhausted the nourishment obtainable. The flask with its undisturbed contents is then subjected to a heat that effectually kills the whole of the microbes. The solution is subsequently placed in sterilized (rendered by heat free of microbes) bottles for transport. As the microbes are dead, it is absolutely impossible for the solution to convey the plague. Thus, if put into the human body, or scattered by accidental breaking of the bottle in dwellings, no disease propagation can possibly result. Although the microbes are destroyed by the heat, and are, therefore, incapable of producing further toxins in the solutions, those that were produced during cultivation in the flask remain. If this solution be introduced under the skin, the effects of the toxins as in the natural disease are

produced ; but there being no living microbe, it is possible to know that the amount in the system cannot exceed a known quantity (which it has been definitely ascertained the body can tolerate with safety) as contrasted with conditions in the natural disease, where the living microbes and their toxins multiply indefinitely. The presence of the toxins and the dead microbes in the blood excite the living cells of the tissues to a production of antitoxin and, after the lapse of some time, bactericidal substances, and thus bring about artificial protection of the body from entrance of the living microbe ; just as if an attack of the disease naturally acquired had been recovered from. It has been found by Dr. Lehmann that the serum of the blood of an animal that has been subjected to inoculation by this method is capable of killing the living microbe, which is of itself a distinct proof that Haffkine's mode of inoculation can bring about changes in cells of the body and the composition of the blood, that will protect it from invasion by the plague microbe.

The haffkinine is introduced usually in the upper part of the arm by means of hypodermic syringe, under conditions of such attention to cleanliness that, neither from the exterior of the skin itself, nor from the air, should it be possible for extraneous microbes to be introduced. At the end of about six hours from the time of inoculation, the patient is subjected to fever, which lasts from a few hours up to three days, according to the dose injected, and the individual susceptibilities of the patient. Subsequently, for a few days, there exists a feeling of tenderness and, perhaps, slight swelling at the point of inoculation. This gradually subsides ; but there may persist, for a short period, a small enlargement under the skin. It will be seen, therefore, that the operation, although involving an attack of fever such as few people in this country are not accustomed to undergo as a result of malaria, is not more serious than vaccination, with which there exists greater familiarity.

As to protection from plague afforded by inoculation, statistics extending over many thousand cases in infected areas have been subjected to criticism both friendly and unfriendly. At Undera, in the Bombay Presidency, certain members of the families were inoculated and others not ; so that the subjection to risk of infection might be fairly equal. After the lapse of forty-two days, during which the epidemic continued to prevail, the following was the result obtained in *infected* households :—

Uninoculated members of the family.			Inoculated members of the family.		
Total uninoculated in the family.	No. of attacks amongst them.	No. of fatal attacks.	Total inoculated in the same family.	No. of attacks amongst them.	No. of fatal attacks.
124	54	37	250	50	20
	43·5%	29·5%		20%	8%

Under similar conditions, inoculation, however, being conducted during various periods, the following results were obtained in Lower Dumaun up to sixty-six days after inoculation in *infected* households :—

Uninoculated members of the family.			Inoculated members of the family.		
Total uninoculated in the family.	No. of attacks amongst them.	No. of fatal attacks.	Total inoculated in the family.	No. of attacks amongst them.	No. of fatal attacks.
64	27	26	71	8	3
	42·2%	40·6%		11·3%	4·2%

The attack rate in Dumaun amongst inoculated persons *subject to the usual risks of infection* of the general population was 3·6 per cent. But under the influence of more than



one inoculation, it has been found that the protective influence is increased ; so that it is now advised that, in the case of those subjected to continued risk of infection, a second inoculation should be undergone not later than six months after the first. According to a correspondent in the *Lancet*, the difference between those inoculated *once* and *twice* in Dharwar is expressed as follows : "In 5,712 *once* inoculated there were 69 attacks, and in 3,349 *twice* inoculated there were nine attacks, or a difference of nearly 1 per cent. in favour of the re-inoculated." In the Khoja community, which has been closely under his observation in Bombay, Mr. Haffkine reports that the re-inoculated were attacked at the rate of .07 per cent., against .75 per cent. in case of those who had never been inoculated. It will thus be seen that inoculation presents a very valuable protection against attack, but, as a life-saving agency, its position is of still greater importance. *Statistics that are indubitable go to show that if an inoculated person be attacked, he has from 80 to 90 per cent. better chances of recovery than an uninoculated person.*

Inoculation up to date has not been proved to be capable of stopping an attack of plague in the case of a person who has been infected before the operation, and is therefore undergoing incubation. Thus, it not unfrequently happens that persons who have been exposed to contagion, and who have subsequently been inoculated have developed plague. Under these circumstances, the uneducated of the people openly assert that the inoculation was the cause of the plague. A consideration of the fact that incubation may run on for a period of ten days will get rid of this error.

Another popular error exists, which requires correction at the hands of Sanitary Inspectors, when their advice is sought as to inoculation. In the process of the manufacture of haffkinine, it has hitherto not been possible to secure that the strength of the toxin produced is always the same, seeing that plague microbes employed from time to time

may differ in virulence. But, M. Haffkine, before its dispatch by him, takes the precaution of experimentally ascertaining the correct dose for an adult male in each instance. Consequently, the dose of haffkinine to be given from one bottle may differ largely from that in the case of another. Seeing this, the ignorant are apt to be of opinion that the action of the operator is guided by treacherous feelings. Further, it is at the discretion of a medical officer to decrease the dose as shown on the bottle, should he be of opinion that the person is of small bulk, of weakly constitution, or suffering from any disease. In the latter case, the operator may find it desirable to give a small dose at intervals of time, instead of giving the full dose at once. It is necessary for Sanitary Inspectors to explain these simple facts to the people.

Much alarm has been caused by ignorant or mischievous persons stating that inoculation against plague is compulsory. This is absolutely false. It is at the option of the poor and rich alike to accept or refuse it as they choose. Sanitary Inspectors in urging the advantages of this operation, should make this fact perfectly clear to all enquirers.

Whilst the advantages to be derived from use of inoculation are indubitable, it is necessary to protest against the opinion held by certain authorities that it is possible to lay aside all sanitary measures, in favour of this method of contending against the disease. Under such a system in practice, it is impossible, during a first epidemic, to secure that inoculation shall be accepted with sufficient fulness by the people to prove a protective measure of value to the community, as contrasted with the individual; the unrestrained sick would infect, in the absence of universal inoculation, neighbouring uninoculated populations, and the process would be repeated throughout a susceptible area; it cannot stay the disease when incubation has commenced, hence, in the absence of sanitary measures,

even the inoculated would be a source of danger; and, although of vast usefulness against attack, it is not an absolute protection. Hence, it is necessary to regard inoculation not as a measure that can replace sanitary methods, but as one which is a very valuable adjunct to them.

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## PART II.

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# HINTS FOR VILLAGE SANITATION.



The following are extracts from Memoranda issued by the author from time to time that may be found useful in regulating sanitary details of Health Camps, and in improving the general sanitary condition of villages.

### Conservancy.

The difficulty in obtaining toties is a matter that must be allowed for in most localities; hence, measures that would ensure disposal of faecal matter without handling must be employed. This can be arranged for either by the use of the trench system or the Jewish conservancy system. With the former method all officers are familiar; but, as a result of adopting principles now found to be erroneous, the tendency is to make trenches of absurd depths and breadths. Thus, a very common size for a trench is 3 feet wide and 3 feet deep. Yet such trenches can only be employed by persons squatting at the edge, and it has time after time occurred that the earth has given way, or the persons have overbalanced themselves with very dire consequences. But safety and convenience are not the only reasons why these huge excavations should be abandoned; it has been found of recent years that nitrification proceeds actively only within the first 18 inches of soil and that, indeed, the most active change occurs within the first 6 inches from the surface. Consequently, it is well, where final burial of the faecal matter is contemplated, to use at no time a depth exceeding 18 inches and, preferably, not to go deeper than 1 foot. As regards breadth, trenches should not be broader than 9 inches, this being the usual span from heel to heel of a native squatting. With this limited breadth, instead of the person using the trench sitting at the side, the position assumed should be that of *squatting direct across the*

shallow trench; the result is that both fæces and urine are received into the trench and consequently the surroundings are kept dry, whereas, in the case of the old form the approach or pathway became unusable, on account of soakage from urine and washings for ablution. Diagram A\* shows a trench latrine formed on this system. It will be noticed that the space afforded within the latrine is extremely narrow, the object being to ensure that it shall be comfortable to squat in no other place than that appointed for the purpose.

The use of trenches should get rid of the objection on the part of low caste men, who are not professional toties, undertaking superintendence. All that is required is that after defæcation the person concerned, or at least the attendant, should cover the mass with dry earth derived from the excavation. As soon as the trenches are filled, the bamboo tatty sides can be shifted to another position.

Where toties are obtainable, the trouble of constantly shifting the tatties may be got over, by using the form shown in diagram B. Here a small filter is arranged for disposal of urine and washings, whilst the trench may be made to serve a considerable period by causing it to be partially filled with dry earth daily, which should be removed from time to time as defiled. In both forms of latrine, it is essential that fæcal matter deposited be instantly covered with dry earth, so that it should be neither offensive to sight nor smell. Unless this is seen to carefully, no form of latrine will be willingly resorted to by natives.

In the opinion of the undersigned, however, the method that is easiest to work, and is received with the least opposition by natives, is that referred to above as the Jewish conservancy system. This is conducted as follows (diagram C.):—A place is marked off in a field conveniently close to the works—say, not exceeding 100 yards distance—by means of four flags. Within the square space so selected are made pits at distances of 3 feet from each other. These pits measure 6 inches in diameter and 8 inches deep. On one side of each pit is placed the earth excavated from it, and a piece of split bamboo 2 feet or so high, having a small coloured rag at the end is fixed at the same side as the piled earth. On the side nearest the work is

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\* The diagrams referred to are not re-produced.

placed, so as to preserve the sitters from observation, a movable screen, that may be made of jungle tree branches intertwined with any foliage that will secure protection from sight. On the site, it is necessary to retain a man on duty throughout working hours. Persons on arrival will be permitted to select any hole they may choose—an arrangement which gives all the privacy an ordinary native requires. The man on duty sees that defæcation occurs in the holes *only*. *The moment a person retires,\** it is the attendant's business to proceed to the hole used, and remove the split bamboo—showing that the hole is not to be again used—and with a movement of his foot to throw the earth piled as stated above into the pit. If the attendant be too 'nice' to do this himself, there is no reason why, without much pressure, he should not be able to convince the person who has used a pit that it is his duty to move the earth with his foot, and thus cover the excreta. This system is absolutely odourless, and when properly worked a spot, when it is in progress, can be visited at any time without either eye or nose having cause for offence. To make these holes of an uniform size and depth requires, however, the consumption of much time, and is not often satisfactorily accomplished, as ideas of size differ enormously in individuals of the cooly class; hence I have designed "Jewish conservancy spades," obtainable at Messrs. Sultan & Co., Royapettah, Madras, for the purpose. These by two movements—rapidly make the pits of the exact size demanded.

### Wells.

A typically sanitarily safe water may be held to be an underground water derived by filtration through clean soil, at such a distance from habitations as to be beyond risk of contamination through the soil or sub-soil. To obtain this water, and so deliver it that it shall be as free of contamination as when it has reached its supporting impervious stratum after filtering through the pervious earth—a splendid microbe obstructionist

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\*The tendency in working this system is for the attendant to allow several holes to remain open, so as to make one job of the whole and thus prevent the trouble of many journeys. If this be permitted, the advantage of quick deodorization and concealment from sight is frustrated, and the arrangement must prove a failure. Strict discipline on this point must, therefore, be maintained.



is, therefore, an object well worth attempting. Bored wells being financially out of the question in this instance, this aim can best be secured by the use of Norton's tube wells (otherwise known as Abyssinian wells) which are iron tubes varying in diameter from one to four inches. They are made in lengths which can be screwed together; one length is provided with a sharp point, and above this are numerous openings. The object aimed at is the forcing of the iron tubing into pervious soil until the water stratum is reached. To accomplish this, special driving apparatus is used, which any overseer would readily understand how to employ. Water having been struck—as can easily be ascertained by using the little plumb supplied with the apparatus—a pump is screwed on the end of the tube protruding from the ground. The water first obtained by pumping is usually muddy, and looks an unsavoury mixture. Hence, it is worth while remembering that the tube being sunk within more or less loose earth it is but reasonable to expect that for a certain time this should be delivered with the water. Continuous pumping and, in bad cases, washing out by means of the “cleaning pipes” with water derived from elsewhere, until the débris cease appearing at the pump should be pursued. The longer such a well is used the better becomes the reservoir, which is formed round the tube point in the earth. When the tube is much soaked by sand it may be withdrawn, cleared and then re-inserted through a mass of pebbles previously rammed down the hole made, or dropped through a tube into position so as to surround the perforations. These wells are cheap, their average cost, *Burns & Co., Calcutta*, being as follows:—

—	Tube 1½", pump barrel diameter 3".	Tube 2", pump barrel 4".
	RS.	RS.
Tube well 30 feet ... ..	50	100
Extra tube per foot ... ..	2	3
Field pump (extra strong) ... ..	30	...
Complete set of combined driving and withdrawing apparatus, complete ...	200	250

In respect to the "driving apparatus," &c., it must be remembered that one will suffice for the sinking of any number of wells. The yield of Norton tube wells may be taken as follows:—

Size of tubes in inches.						Gallons per hour.
1 $\frac{1}{4}$ "	...	...	...	...	...	150 to 600
2"	...	...	...	...	...	300 to 1,200
3"	...	...	...	...	...	600 to 2,400
4"	...	...	...	...	...	1,200 to 4,400

These wells are, therefore, cheap, and thoroughly efficient in that they deliver water direct at the surface in a manner that forbids contamination, especially if leakage along the tube from above downwards be frustrated by a small concrete ring at the surface. Although it is possible to use them under special conditions in impervious strata by using boring, for all practical purposes, the employment of these wells should be confined to pervious strata and to depths not exceeding 50 feet. There are large tracts in the Ceded Districts where these wells would not be of utility, on account of the presence of rocky strata, but, on the other hand, there are also numerous places where the sub-soil water is found within strata easily penetrable by driving. One merit worthy of being held in mind is that they can be shifted from place to place, and this is often of great use in tracts where sweet and brackish water are so often found in close proximity. They are, therefore, useful also in exploring for a suitable quality of water previous to sinking ordinary dug wells. If the water is within 25 feet of the surface, the common suction pump sold with the tube wells suffices to effect lifting; if beyond this, deep well pumps must be employed—when the subsidiary arrangements requisite are not worth the trouble of abiding by this description of well. A further sphere of utility for them would be found in attempting to get water from ordinary dug wells or tanks that have run dry. Provided the bottom of the well or tank be pervious, a Norton's tube can readily be sunk within it, with the result of obtaining water at a depth that may require its being pumped up; or, it may chance that water struck being under pressure it will rise within the limits of the old dug well through the tube, no pump being necessary.

*Wells with pumps.*—The next best approach to security is obtainable by the use of ordinary dug wells provided with an impervious lining and backing, and covered in so as to prevent either light or dust entering and furnished with a suction pump at the side—not immediately over it—a condition that is easily attainable, by using a bend on the suction pipe if the depth is not over 25 feet (*vide* diagram D). The cost of common suction pumps suitable for this purpose is as follows:—

*Revolving top cistern pump (Burn & Co., Calcutta).*

Diameter of cylinder.						Capacity per stroke.	Price of iron pump.
						GALS.	RS.
2	...	...	...	...	...	$\frac{1}{12}$	15
$2\frac{1}{4}$	...	...	...	...	...	$\frac{1}{10}$	17
$2\frac{3}{4}$	...	...	...	...	...	$\frac{1}{7}$	21
3	...	...	...	...	...	$\frac{1}{6}$	24
$3\frac{1}{2}$	...	...	...	...	...	$\frac{1}{4}$	34
4	...	...	...	...	...	$\frac{1}{3}$	43

A very good modification of this arrangement is obtainable in dealing with an unlined well newly sunk by placing an iron water-pipe, or glazed stoneware, or cement, pipe with perforations at the end, so as to make a continuous shaft from the bottom to the top of the well. The well space surrounding this shaft should then be filled in with clean metal, gravel, and sand in successive layers from the bottom. Through the shaft left communicating with the water should then be placed the ordinary suction tube of a pump.

As regards expenditure for this system, it must be remembered that, as in the case of the Norton's tube wells, if it be found in shifting camp that the cost of leaving the apparatus *in situ* cannot be undergone, there is nothing to prevent the pump being moved, and, for the matter of that, if it be thought worth while on account of lining the shaft being formed of pipes, these also could be removed at the cost of a little excavation in loose soil.

*Re-modelling old wells.*—The well most commonly found in the Ceded Districts is a huge square structure provided with steps leading down to the water. This description of well is of



course absolutely dangerous as to infection by cholera, in that the water is exposed to contact with chatties, ropes, hands and feet—very often of hundreds of persons per day, irrespective of the occasional washing of clothing and of the person for which these wells are also employed. The very least sanitary precaution that should be taken in the case of such wells is to insist upon the abolition of the use of the steps, by effectually blocking them up, so as to render approach *impossible*, and fixing at the surface level some form of pulleys. A guard of a caste that will satisfy all ordinary persons as to caste requirements should be stationed at the well. Where this is feasible, he alone should be permitted to draw water with metal buckets provided for the purpose; but when this will not be tolerated, or, where the number of persons to be served would render it impossible on account of the labour involved, a waterman per caste, or a suitable number of buckets per caste and ropes—preferably light chains—should be available.

Occasionally such wells are so built that it would not be possible to make use of pulleys fixed at the surface at the ground level. In this case, it is often feasible to erect within the well a platform that would at least prevent feet and hands being put into the water; or a platform may be made so as to project slightly over wells. In both instances, these platforms should be made impervious, and with a slope, if on the ground surface, to a suitable outlet, and, if within the well, to a cistern whence drippings and foul water can be removed by hand or pump. Such platforms may be devised of wooden supports with wooden flooring caulked and tarred, or of bamboo matting supported on sound frames, and covered with clay having gravel above it; or corrugated iron may be employed with, or without, a layer of concrete above it.

In dealing, however, with a 'step well' that is likely to be long in use, it is advisable that a modification of the principle mentioned in the close of the last paragraph be adopted: that is, by building a new round well within the old structure, or by placing in it a shaft of iron water pipes, or stoneware sewage pipes, or by even employing the common earthen rings used for pot wells; so that the danger of direct approach by

steps can be got rid of, by the simple device of contracting the area by filling with clean material. If the depth is such as will permit of the use of a common suction pump, this should be employed.

But this method need not solely be followed in re-modelling wells already made; it may be usefully applied in dealing with the huge unlined excavations now frequently found at the sides of roads on which famine works are situated. One excuse for making these excavations after the manner of the country, instead of forming small circular wells, is that labour is provided for famine workers; but, if this method of filling in with clean material be adopted, the labour in making the useless area could still be permitted, whilst the enormous cost necessary to line such wells with masonry—*plus* steps to make them easy of defilement—would be avoided. As a fact, unless some such mode of contracting the area be followed, the majority of these excavations never will be lined, and consequently will soon be filled in with *débris*. As an allied subject undersigned would point out that it would be of much advantage, if the object lesson of wells being made in this manner, could be afforded *ryots*. The main expense in making wells, which are so much needed in the Ceded Districts, is the great cost of the masonry lining. This, in the method described, is reduced to a minimum. The only contention against this mode can be that in the large wells, the rate of withdrawal by ‘*mots*’ can be quick, for the reason that friction, to which the water is subjected in passing through the earth pores to fill up the loss of the amount already collected in what is virtually a reservoir, is diminished. But by arranging to have a bottom layer of rubble or boulders, friction is reduced, when compared with what it would be were undisturbed strata to be passed through; so that, beyond the effects of displacement on storage, the *ryots* would be as well off as with the enormous open and expensive wells now employed.

*Protection of tanks.*—A very common impression is that where a large mass of water is concerned, it is not necessary to go to the trouble of special means of protection. Yet, the only safe practice to follow as to tanks of the ordinary description found in this Presidency is to regard them solely as sources of

water-supply—not as part of the system of distribution. Usually, a readily adaptable procedure is to fence the tank, and to sink at the sides one or more wells in the banks, which will be supplied sufficiently by percolation. If the use of pumps is out of the question, these wells may be formed in accordance with the usual mode pursued by natives in sinking pot wells, except that a backing of clay should be used above the lowest water level and an impervious platform of concrete—cement-plastered—or of slabs on concrete with cement pointing may, if the structure is likely to be used for any length of time, be employed with advantage. But, at times, tanks may be of a character where this mode may not be easy of adoption. In this case, impervious platforms should be erected on the same principle as mentioned in paragraph 25 *supra*, but so arranged as to pass into the water the required distance.

Where, in connection with tanks, the washing of clothing is requisite, it should be arranged that the water be removed with all the care insisted upon in the case of drinking water, and the cleansing of clothing be proceeded with at a spot distant from the tank.

*Wells with beams across.*—It is a common practice for beams to be thrown across wells, on which persons stand to draw water. Contamination from drippings from the feet must therefore occur. Beams should be removed in such instances, and ordinary drawing be insisted on.

*Lifting to tanks.*—It need hardly be said that both in the case of tanks and wells a far better way than any described above is to lift the water to covered tanks by pumping,\* and thence let the water be drawn for distribution by taps. It should be employed, wherever financially feasible, in preference to all others.

*Rivers.*—Portions should be marked off by flags (and if the stream is small, by wires stretched from bank to bank) for drinking purpose, for bathing, washing, and for cattle, in the order named going with the current, that is, the drinking ghat should be fixed up stream. It must be remembered, in respect to small streams and rivers, that there is no more

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\* The "Sultan lift" offers a cheap alternative. It can be adapted so as to offer a considerable measure of sanitary safety.



dangerous time as to conveyance of cholera than with the first freshes after rainfall. Hence it is advisable, if there be reason to know that cholera is in any part above stream, not to allow famine workers to use such water. Where compulsion cannot be used, the advice to boil the water should at least be given by tom-tom at frequent intervals. Beyond this, it would be advisable to sink pot wells, or Norton's tube wells, on the bank, and require that these be employed, at any rate, so far as distribution on works by public agency, is concerned. Some degree of safety may also be attained by causing the water to undergo rough filtration through gravel; or, still better, if the rate of withdrawal will not render this out of the question, by requiring an area that renders the whole proceeding too expensive, sand may be used above the gravel—it being held in mind that both gravel and sand must be obtained from sources free of suspicion of contamination by human beings. This can be effected by making an excavation in the bank, and filling this in after the manner of a filter bed. Within this filter bed could be sunk pot wells in which the water would arrive after filtration, on admission of the river water to the surface of the filter bed. It may happen in making such an effort that sufficient good sub-soil water would be reached to prevent it being necessary to look to the river as a source. In this event; there would be no object in using the sand layer—the sub-soil water would simply percolate through the gravel to the pot wells.

Where the sandy bed of a river is dealt with, if the native had his own way, he would make a huge excavation—a so-called 'spring' in which he would wash, and withdraw his water. Instead of allowing this, numerous pot wells should be sunk in the sandy bed.

### **Distribution of Water-supply in Camps where no Pipe System is available.**

It is not advisable to use chatties carried by coolies, as contamination by means of their hands and clothing may occur. Wherever possible casks, mounted on wheels and drawn by men or bullocks, should be employed.

The capacity of these casks should be carefully estimated and be painted on them in large characters.

The number of trips per day necessary for the supply should be definitely settled.

The following is a useful formula (Hurst) for calculating the capacity of casks :—

$D, d$  = inside diameters at the heads.

$M$  = inside diameters at the bung, and  $L$  = the length, all in inches : then

the capacity in imperial gallons =  $\cdot 0014162 L (Dd + M^2)$   
or,

“Take the bung diameter in inches, by measuring the circumference at the bung, and making an allowance for the thickness of the staves: square the bung diameter, and multiply by 39. Take the head diameter in inches by direct measurement, and square it, and multiply by 25. Multiply one diameter by the other, and multiply by the length of the cask in inches, then multiply by  $\cdot 000631473$ , and the result is given in gallons” (Nisbit).

Carts should be fitted with cast-iron taps. Their cost is as follows :—

1 inch = Rs. 1-8;  $1\frac{1}{4}$  inch = Rs. 2;  $1\frac{1}{2}$  inches = Rs. 2-12; 2 inches = Rs. 4. If these cannot be employed, on no account should any methods adopted be supplemented by the use of old rags, and the like, to stop leakage.

Chatties and kerosine tins, used for temporary storage should have well-fitting covers. In the case of old kerosine oil tins, this can be managed by using a tin cover with handle at the top and, in the case of chatties, by the ordinary earthen ‘chippa.’

It would be advisable to select a respectable man of good caste, whose whole time should be devoted to guarding the camp water, and seeing that orders as to it are carried out.

On no account should camp inhabitants be allowed to dip their own utensils or hands into the public storage vessels. A cheap and effective arrangement is to use tin ‘Burmese spoons.’\* Simple as the device is, it should go a great way towards securing protection from pollution of water. It has been suggested that large cocoanut ladles would do as well; these, however, present a surface far less safe bacterially.

\* These can be obtained from Messrs. Sultan & Co., Royapetta, Madras.

After use, the 'Burmese spoon' should not be placed on the ground, but should invariably be hung up near the storage vessel by the hook on the handle.

The storage vessels should be placed on a pyal slightly raised, and sloped with gravel or metal to one side, so that spilt water can readily drain from this to a clay-lined gutter. The gutter should be led to a sufficient distance into a pit for disposal by soakage, or for the use of trees.

If there be no suitable shade from trees, the water should be protected by a few slabs if at hand; or a rough thatch of grass, jowari stalks or branches of trees intertwined, may be employed.

The head cooly should particularly see that no water left from the day before is retained in any storage vessels, when fresh water is placed in it.

Once weekly, the water barrels should be disinfected by pouring into them milk of lime (1 part fresh slaked lime to 4 of water) which should be left to soak throughout the night, and be washed thoroughly next morning with water from a safe source and that has been rendered pink by permanganate of potash. The storage vessels should be disinfected with a solution of permanganate of potash of a strength sufficient to maintain a pink colour for half an hour after the vessel has been agitated, or be placed on a fire till too hot to touch.

### Disinfection of Water.

All unguarded or suspicious water-supply sources should be closed by mechanical means, so as to render withdrawal of water *impossible*.

If the water-source is too large to be disinfected within reasonable cost by the permanganate of potash, the alum process may be employed in lieu.

Alum (Hind. *Phitkari*, Tam. and Tel. *Pati-karam*) is obtainable in ordinary bazaars at cheap rates. If the water is soft, the use of alum should be preceded by the use of stale lime or chalk, in the proportion of one grain to the gallon. The amount of alum required is from 4 to 6 grains, according to the amount of organic matter *alias* 'dirt' with which the well seems charged. A ready reckoner for four grains per gallon is subjoined:—



Table I.—Quantity of Water contained in Circular Wells and Tanks per Foot in Depth with the quantity of Alum required.

Diameter.		Contents.	Quantity of Alum required per foot.			Diameter.	Contents.	Quantity of Alum required per foot.			
Ft.	In.	Gals. per foot.	lb.	oz.	Grains.	Ft.	In.	Gals. per foot.	lb.	oz.	Grains.
0	1	·034	0	0	0·136	2	6	30·7	0	0	122·8
0	1½	·076	0	0	0·304	2	9	37·1	0	0	148·4
0	2	·135	0	0	0·540	3	0	44·2	0	0	176·8
0	2½	·212	0	0	0·848	3	3	51·1	0	0	204·4
0	3	·305	0	0	1·22	3	6	60·2	0	0	240·8
0	4	·54	0	0	2·16	3	9	69·0	0	0	276·0
0	5	·85	0	0	3·4	4	0	78·5	0	0	314·0
0	6	1·22	0	0	4·88	4	6	99·4	0	0	397·6
0	7	1·66	0	0	6·64	5	0	122·7	0	1	10·8
0	8	2·17	0	0	8·68	5	6	148·5	0	1	114·0
0	9	2·75	0	0	11·0	6	0	176·7	0	1	226·8
0	10	3·39	0	0	13·56	6	6	207·4	0	1	349·6
0	11	4·12	0	0	16·48	7	0	240·5	0	2	2·0
0	12	4·91	0	0	19·64	7	6	276·1	0	2	144·4
0	13	5·75	0	0	23·00	8	0	314·2	0	2	296·8
0	14	6·67	0	0	26·68	8	6	354·7	0	2	458·8
0	15	7·67	0	0	30·68	9	0	397·6	0	3	150·4
0	16	8·72	0	0	34·88	9	6	443·0	0	3	332·0
0	18	11·04	0	0	44·16	10	0	490·9	0	4	43·6
1	9	15·0	0	0	60·0	11	0	594·0	0	4	456·0
2	0	19·6	0	0	78·4	12	0	707·0	0	5	128·0
2	3	24·8	0	0	99·2	13	0	809·0	0	6	356·0

Table I.—Quantity of Water contained in Circular Wells and Tanks per Foot in Depth with the quantity of Alum required—(Continued).

Diameter.	Contents.	Quantity of Alum required per foot.			Diameter.	Contents.	Quantity of Alum required per foot.		
		Gals. per foot.	lb.	oz.			Gals. per foot.	lb.	oz.
Ft. In.				Grains.	Ft. In.				Grains.
14 0	962	...	8	8	110 0	59,396	41	2	464
15 0	1,104	...	9	96	120 0	70,685	49	1	20
16 0	1,256	...	10	224	130 0	82,956	57	7	144
17 0	1,418	...	11	392	140 0	96,211	66	9	364
18 0	1,590	...	1	120	150 0	110,447	76	8	188
19 0	1,772	1	2	368	160 0	125,664	87	3	96
20 0	1,963	1	4	172	170 0	141,862	98	6	88
25 0	3,068	2	1	272	180 0	159,044	110	5	176
30 0	4,418	3	...	392	190 0	177,006	123	...	344
35 0	6,013	4	2	52	200 0	196,350	136	4	120
40 0	7,854	5	5	216	250 0	906,796	213	...	304
45 0	9,940	6	10	400	300 0	441,788	306	9	272
50 0	12,272	8	6	120	350 0	601,322	417	7	8
55 0	14,850	10	3	360	400 0	785,400	545	5	...
60 0	17,671	12	3	124	500 0	1,227,190	852	2	280
65 0	20,740	14	5	20	600 0	1,767,150	1,227	2	120
70 0	24,053	16	8	212	700 0	2,405,290	1,670	4	40
75 0	27,611	19	2	44	800 0	3,141,600	2,190	...	...
...	...	...	...	...	900 0	3,975,750	2,760	11	120
80 0	31,416	21	9	384	1,000 0	4,908,750	3,408	...	120
90 0	39,758	27	7	152	.....	.....	...	...	...
100 0	49,088	34	1	32	.....	.....	...	...	...

Table II.—Quantity of Water contained in Square Cisterns or Tanks per Foot in Depth with the quantity of Alum required.

Length of side.		Contents.	Quantity of Alum required per foot.			Length of side.	Contents.	Quantity of Alum required per foot.			
Ft.	In.	Gals. per foot.	lb.	oz.	Grains.	Ft.	In.	Gals. per foot.	lb.	oz.	Grains.
1	0	6·25	0	0	25	30	0	5,625	3	10	420
1	6	14·06	0	0	56·24	35	0	7,656	5	3	384
2	0	25·00	0	0	100	40	0	10,000	6	11	160
2	6	39·06	0	0	156·24	45	0	12,656	8	9	224
3	0	56·25	0	0	225	50	0	15,625	10	10	100
3	6	77·56	0	0	310·24	60	0	20,500	14	2	400
4	0	100·00	0	0	400	70	0	30,625	21	3	100
4	6	126·56	0	1	26·24	80	0	40,000	27	9	160
5	0	156·25	0	1	145	90	0	50,625	35	1	420
6	0	225	0	1	420	100	0	62,500	43	4	400
7	0	306	0	2	264	125	0	97,656	67	9	384
8	0	400	0	3	160	150	0	140,625	97	7	420
9	0	506	0	4	104	200	0	250,000	173	7	160
10	0	625	0	5	100	300	0	562,500	390	7	240
11	0	756	0	6	144	400	0	1,000,000	694	5	160
12	0	900	0	7	240	500	0	1,562,500	1,085	...	400
15	0	1,406	0	11	344	1,000	0	6,250,000	4,340	3	160
20	0	2,500	1	8	400	.....		.....	...	...	...
25	0	3,906	2	8	264	.....		.....	...	...	...



In dealing with very large tanks where even the cost of alum disinfection would prove excessive, much good may be obtained by calculating for disinfection the mass of water included within twenty-five feet all round the tank,\* or, if even this be expensive, *one side*—the side where water is drawn by the people.

The correct distribution of lime and alum in tanks can be arranged by suspending two new cooly baskets between two poles as floats, and by dragging them backwards and forwards by means of ropes till the contents of the baskets are dissolved.

### Disinfection by the Permanganate of Potash Process.

The subjoined table gives the proportion in which permanganate of potash should ordinarily be used for wells and tanks:—

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\* 1 Cubic foot of water = 6·24 gallons.

Table I.—Quantity of Water contained in Wells and Circular Tanks per Foot in Depth (Hennell) with the quantity of Permanganate of Potash required.

Diameter.		Contents.		Quantity of Permanganate of Potash required per Foot.		Diameter.		Contents.		Quantity of Permanganate of Potash required per Foot.	
Ft.	In.	Gals. per foot.	lb.	oz.	Grains.	Ft.	In.	Gals. per foot.	lb.	oz.	Grains.
0	1	.034	0	0	.05950	2	3	24.8	0	0	43.40000
0	1½	.076	0	0	.13300	2	6	30.7	0	0	53.72500
0	2	.135	0	0	.23625	2	9	37.1	0	0	64.92500
0	2½	.212	0	0	.37100	3	0	44.2	0	0	77.35000
0	3	.305	0	0	.53375	3	3	51.1	0	0	89.42500
0	4	.54	0	0	.94500	3	6	60.2	0	0	104.35000
0	5	.85	0	0	1.48750	3	9	69.0	0	0	120.75000
0	6	1.22	0	0	2.13500	4	0	78.5	0	0	137.37500
0	7	1.66	0	0	2.90500	4	6	99.4	0	0	173.95000
0	8	2.17	0	0	3.79750	5	0	122.7	0	0	214.72500
0	9	2.75	0	0	4.81250	5	6	148.5	0	0	259.87500
0	10	3.39	0	0	5.93250	6	0	176.7	0	0	309.22500
0	11	4.12	0	0	7.21000	6	6	207.4	0	0	362.95000
0	12	4.91	0	0	8.59250	7	0	240.5	0	0	420.87500
0	13	5.75	0	0	10.06250	7	6	276.1	0	1	45.67500
0	14	6.67	0	0	11.67250	8	0	314.2	0	1	112.35000
0	15	7.67	0	0	13.42250	8	6	354.7	0	1	183.22500
0	16	8.72	0	0	15.26000	9	0	397.6	0	1	258.30000
0	18	11.04	0	0	19.32000	9	6	443.0	0	1	337.75000
1	9	15.0	0	0	26.25000	10	0	490.9	0	1	421.57500
2	0	19.6	0	0	34.30000	11	0	594.0	0	2	164.50000

Table I.—Quantity of Water contained in Wells and Circular Tanks per Foot in Depth  
(Hennell) with the quantity of Permanganate of Potash required—(Continued).

Diameter.		Contents.	Quantity of Permanganate of Potash required per Foot.			Diameter.		Contents.	Quantity of Permanganate of Potash required per Foot.		
Ft.	In.	Gals. per foot.	lb.	oz.	Grains.	Ft.	In.	Gals. per foot.	lb.	oz.	Grains.
12	0	707.0	0	2	362.25000	100	0	49,088	12	4	156.00000
13	0	809.0	0	3	103.25000	110	0	59,396	14	13	255.50000
14	0	962	0	3	371.00000	120	0	70,685	17	10	323.75000
15	0	1,104	0	4	184.00000	130	0	82,956	20	11	360.50000
16	0	1,256	0	5	10.50000	140	0	96,211	24	0	369.25000
17	0	1,418	0	5	294.00000	150	0	110,447	27	9	344.75000
18	0	1,590	0	6	157.50000	160	0	125,664	31	6	287.00000
19	0	1,772	0	7	38.50000	170	0	141,862	35	7	196.50000
20	0	1,963	0	7	372.75000	180	0	159,044	39	12	77.00000
25	0	3,068	0	12	119.00000	190	0	177,206	44	4	362.50000
30	0	4,418	1	1	293.50000	200	0	196,350	49	1	174.50000
35	0	6,013	1	8	22.75000	250	0	306,796	76	11	80.52000
40	0	7,854	1	15	182.00000	300	0	441,788	110	7	67.00000
45	0	9,940	2	7	332.50000	350	0	601,322	150	5	126.00000
50	0	12,272	3	1	38.50000	400	0	785,400	196	5	262.50000
55	0	14,850	3	11	175.00000	500	0	1,227,190	306	12	332.50000
60	0	17,671	4	6	299.25000	600	0	1,767,150	441	12	262.50000
65	0	20,740	5	2	419.50000	700	0	2,405,290	601	5	70.00000
70	0	24,053	6	0	92.75000	800	0	3,141,600	785	6	175.00000
75	0	27,611	6	14	174.25000	900	0	3,975,750	993	15	...
80	0	31,416	7	13	290.50000	1,000	0	4,908,750	1,227	3	...
90	0	39,758	9	15	14.00000	...	...	...	...	...	...





Although this table fixes the proportion of permanganate of potash (1 to 40,000) as sufficing \* in dealing with water of ordinary degrees of purity, it very often happens that the water dealt with may require more than that stated, on account of its being contaminated with an excess of organic matter. In this case, after the amount fixed has been used, it should be observed whether the water has an unchanging pink colour for half an hour; if not, additions must be made cautiously till this results. The addition of permanganate should be made by mixing it with water withdrawn from the source to be disinfected in any convenient vessel, and in convenient proportions. As soon as dissolved, the contents of the vessel (*e.g.*, a kerosine tin or chatty) should be poured into the well, and by sinking the vessel, and withdrawing it rapidly, the whole should be put into a state of commotion, so as to promote general mixing.

It is very rarely when the reason for using the 'medicine' has been explained to natives that they object to its use. The precaution of explaining should always, however, be taken, as any discovery of alteration of colour is liable to be followed by panic. The colour usually fades within twelve hours completely, so that it is best to disinfect in the evening, and next morning all is found as usual. If it is necessary to get rid of the colour quickly, alum may be used after the permanganate as above described.

### **Makeshifts for Sewage Disposal in the Absence of Sewerage Systems.**

*The use of short lengths of drains.*—(1) Where complete schemes for sewage removal by an organized sewerage system do not exist, the next best method is to select small plots of land at a point (1) as centrally situated with regard to the area to be drained as feasible, (2) at such a level that it should be possible by the use of drains to secure the flow of sewage thither without the aid of lifting apparatus, (3) so situated that should overflow of sewage occur owing to rainfall, no contamination of

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\* Mr. Hankin fixes this strength as sufficing for dealing with the cholera microbe. His experiments point to even less strength being inimical to the plague microbe.

drinking-water supplies in the neighbourhood need occur, (4) and not in the immediate neighbourhood of wells used for drinking purposes, lest contamination of water-supply by sub-soil soakage should take place. It is very rarely that some such place cannot be found within a reasonable distance of dwellings.

(2) If the levels will permit of it, the sewage should be received into a cistern above ground furnished with a syphon, which would discharge the sewage automatically on a definite amount of sewage being collected. If the levels will not permit of this, the sewage should be received into a sewage-collecting well below the ground level, and be lifted by means of a piccottah or other simple method for disposal.

(3) As to disposal of sewage so collected, any person accustomed to conduct irrigation of crops will understand not only how much sewage to use, but also how to arrange the ground for its receipt. Sugar-cane, paddy, brinjals and, in fact, almost any grain or vegetable can be grown under this method, with the effect of securing well-nourished and abundant crops. Hurriali grass especially yields easily managed and rich crops under this treatment.

(4) According to the amount of land available, the sewage from numerous drains serving fairly large areas, or even the contents of a single drain, can be so used. The sewage of from 500 to 1,000 persons could be used per acre.

As regards the method of making drains, it must be remembered that what is contemplated is not the carrying out of a drainage scheme—a matter which must be delegated to a professional Engineer—but the effecting of a temporary expedient for getting rid of sewage in the best and most profitable manner feasible, whilst waiting for the carrying out of major schemes. If such scheme exist, there can of course be no justification for the use of sewage in the neighbourhood of dwellings. Granting then that drains are to be made without the aid of any skilled professional engineering assistance beyond what may be



secured from any person capable of ascertaining levels, it is evident that much trouble as to making them of correct section and preventing dishonest work would be prevented, were ready-made and portable drains available. In this sense, the half-tile glazed stoneware drains sold by Messrs. Burn & Co., of Calcutta, are of advantage. These should be laid in neatly-cut trenches, of which the bottom is at the required gradient, to permit of the sewage flowing with velocity as little below 3 feet per second as possible. For this purpose, as near an approach to the following gradients (Hurst) as possible should be secured :—

Diameter of sewer.		Velocity 2 feet per second.	Velocity 3 feet per second.	Diameter of sewer.		Velocity 2 feet per second.	Velocity 3 feet per second.
Inches	4	1 in 200	1 in 100	Inches	15	1 in 700	1 in 350
„	6	1 in 300	1 in 150	„	18	1 in 900	1 in 450
„	9	1 in 450	1 in 225	„	24	1 in 1,200	1 in 600
„	12	1 in 600	1 in 300	„	30	1 in 1,400	1 in 700

(5) Immediately behind the drains should be a backing of three or four inches of well-puddled clay, or where the drains are expected to last for several years, chunam concrete should be employed. The joints between the drains should be made with Portland cement, in the proportion of one of cement to two of sand. In small schemes of a still more temporary character, tiles of the same shape may be made cheaply locally by potters. Being without glaze, these are of course permeable. If it could be afforded, therefore, it would be well to paint these over with a mixture of boiling pitch and tar, or, where a really lasting coating is desired, the tiles should be bodily plunged into a mixture of this description when boiling. Such tiles should be laid on a bedding of clay, as already described. This is a very rough method; but it is infinitely preferable sanitarily to allowing sewage to soak at thresholds of houses.

(6) *The use of cess-pools.*—This method has several disadvantages, and should never be permitted where it is possible to pursue the system above mentioned. In the first place, the building of a cess-pool correctly would cost each householder served more than if he paid for the portion of a drain common to the rest of the street as far, say, as the boundaries of his own house; secondly, the object being simply temporary collection and not ultimate disposal, it is necessary to make arrangements for lifting from the cess-pool and transport to a locality where it can be finally got rid of. Where this duty is undertaken by a Municipality, it is not likely that it can be accomplished at less cost than of about 1·9 pies for each chatty of water removed, which is more expensive than if pure water were supplied to a town by steam pumping. Where this method is adopted, therefore, the Municipality should insist that the householder himself should undertake the cost; but the Municipality might well arrange to do this for the householder on payment, in which case the form of cart in diagram No. 2 would serve the purpose well, more especially as the pump\* attached would greatly facilitate, and consequently prove economical of, labour.

(7) No cess-pool should be allowed to exist within Municipal limits, unless it be so made as to be impervious. Ordinary cess-pools are so constructed of bad masonry as to facilitate soakage of the sewage into the ground. By thus adding impurity to the soil day by day, it is of course possible for the householder to avoid the expense of removing sewage water; but this he does to the detriment or risk of his own and neighbour's health. What is removed usually from cess-pools, as made hitherto in this Presidency, is simply the sludge which has been left behind in the pervious hole, after the more fluid portion of the sewage has soaked into the soil.

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\* When the cess-pools attended are not large, smaller pumps than here shown carried on, or attached to the sewage cart, might be employed.

(8) A cess-pool if built of brick and lime mortar should be plastered with Portland cement on the interior face throughout; if of stone masonry, all joints should be carefully Portland cement plastered. In either case, at the back of the masonry structure, to prevent the sewage permeating to the soil, there should be a backing of lime concrete or puddled clay. The top should have a covering that will prevent the escape of sewage gas, and be provided with an opening for the admission of the suction tube of a pump to serve the sewage removal cart. Attached to the cess-pool should be a sewage trap and a ventilating shaft. By using these cheap adjuncts, the foul gases will escape into the air above the level of dwellings, and thus both nuisance from odours and danger to health from this source will be prevented.

(9) In certain situations, it might be convenient for the Municipality to arrange to receive the sewage conducted by drains of a street to a single public cess-pool, which should be daily emptied at the expense of the Municipality. Sewage so removed should be carried in sewage removal carts to the nearest plot of ground under sewage cultivation, and be there utilized as described in para. 3.

(10) *Disposal of sewage by filtration.*—Where land is not available for cultivation under the method described in paras. 1—4, the best method of disposal is to use filtration, and arrange for discharge of the purified filtrate into public streams not used for drinking purposes in the immediate neighbourhood. Such a filter may be of a very rough structure. The materials employed need be but earth overlaid with clay for making a substantial bund, common potter-made circular 4 or 6 inch tile drains laid on a bed of metal, and rough stones to permit of ready percolation into the joints of the pipes should be placed over them. The joints should not be joined, but simply placed in juxtaposition. Above these should be placed a layer of gravel and sand. These arrangements will be made clear from the accompanying diagram, (No. 3) which represents a filter made on my



suggestion at Vizagapatam. The following is the Chairman's description of it and of the results obtained :—

“The filter is protected by earthen bunds on four sides as per plan; the interior dimensions at the bottom are 15" × 12", at the top on the sand surface are 22" × 19".

“All interior sides of earthen bund are puddled with 6" stiff clay up to the full length of the bund as well as bottom; over puddling one foot loose rubble stone is packed up; then earthen pipes of 2½" diameter are laid in three rows at an equal distance 3½ feet apart loosely fitted up over rubble stone. Over this 1 foot metal, 3 feet gravel, and 1 foot sand are laid as shown in sections.

“The amount of sewage daily dealt with is about 7,200 gallons (= 750,000 gallons per acre), the filtrate is clear and looks like pure water. At first, a few days after the filter began to work, the filtrate tasted brackish; now it is not so.”

It was calculated that the total cost of this filter was about Rs.50; but much of this cost was incurred by using, to save time, broken road metal, instead of waiting for ordinary rough stone. In this instance, the sewage is simply collected in a cess-pool, and is then lifted by picottah on to the filter.\*

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\*The sewage passes through at a rate measured chiefly by the resistance offered by the sand. In sewage filters of a more permanent nature, it is economical, as to their area, instead of allowing direct outflow, to arrange for the filter beds being filled with sewage, and allowing it to remain in contact with the bacteria-infected material for three hours, and then, drain off slowly. (Dibdin.) Under this system, duplicate filters are requisite to permit of the aëration of one whilst the other is in use. For “make-shift” filters, with which these notes are alone concerned, the form described will act efficiently, so long as amounts passed through are not beyond their purifying capacity. Whilst it is a matter of importance in filters used for the purification of drinking water that the “slimy layer” collecting on the surface should not be disturbed, unless the filter gives signs of being clogged, it is well to remember that this rule does not apply to sewage filters; any layer collecting on the top thick enough to endanger air passing freely through it, should be taken off, and the surface be raked at intervals.

Where none of the methods above described are applicable, I consider rather than not treat the sewage at all, and thus let it collect in stinking pools in the neighbourhood of houses, the best measure to pursue is to use the “Vizianagaram sewage filter.” This filter was designed by me, in imitation of the usually recognized principles in the working of the large sewage filters just described. As the Vizianagaram Municipality readily adopted its use on my recommendation, I have given it the name stated. It consists simply of an iron kerosine drum, such as can be obtained in most bazaars for the sum of Re.1 or Re.1-4-0. In the centre is placed a tin tube, with a funnel-like top. The bottom of the tube is perforated with holes having an united capacity of  $2\frac{1}{2}$  inches, which is the diameter of the tube itself. Round the bottom of the tube is placed a layer of  $3\frac{1}{2}$  inches of rough stones; above this is a layer of 6 inches of good gravel, and above this is a layer of 6 inches of coarse sand. Above the sand is placed a single layer of stones, to prevent the sand being easily washed away. The iron kerosine drum thus arranged is placed below the outlet drain of the house to be served, so as to allow the sewage to enter the tube. Thence the sewage passes gradually by displacement through the stones, gravel, and sand, and finally reaches the top, where it is discharged by the spout direct on the ground. For an ordinary household of five inhabitants, this suffices for the purification of sullage water used within the house. Where the sewage of more inhabitants per house is expected to be treated, the filter must be made correspondingly large. The action of this filter is thus described by the Chairman of Vizianagaram :—

“The domestic sewage filter made when you were here is working excellently well. I have seen the filter myself and found the dirtiest sewage that is let into it coming out so pure that the water will be accepted for drinking by any human being who has not previously known that it

was filtered sewage. . . . The domestic filter requires cleaning every fortnight; in my experience in the present case only two days ago I got the same cleaned and a fresh charge made into the filter."

The action of this filter and of the large sewage filter described in para. 10 is due to the impregnation of the gravel with microbes contained in the sewage, which have the power of breaking up the chemical constituents, provided they are duly supplied with oxygen from the air contained in the interstices of the filtering material. There is also considerable straining action, and perhaps some slight direct chemical change. Hence, after the first three days of use, it will be found to act better than on the first day. In practice, of course, the results with this small filter cannot be of a very exact character, as they must vary with the rapidity with which sewage reaches it from the house. But observation of the sewage outlets of ordinary houses shows that it is rarely discharged from the house in anything but small quantities at a time, and with considerable intervals between each discharge; so that full exposure to air when passing in these films over the filtering material is possible, whilst, if the quantity be large, the amount of impurity it contains is usually proportionately small by reason of dilution. Hence, although this simple arrangement cannot be regarded as completely getting over the difficulty of no correct drainage system being in existence, it certainly is preferable to allowing the gross soakage of sewage usually found in its absence. Moreover, the arrangement is so cheap that there ought to be no excuse for the allowing of the discharge of crude sewage upon the ground, when so simple a means of fairly effectual purification exists.

A somewhat more expensive, but more efficient, household sewage filter can be made by arranging the usual stone, gravel, and sand layers in a square, or round, iron tub. In the position where the gravel would be placed, a



circle of iron gas pipe, fully perforated with holes, ends in a solid tube on the outside, at a level above the whole filter. Through this tube, daily, for a minute, is pumped air by means of a hand-bellows. This can easily be arranged, as a part of the duty performed by the toty, at the morning call. Such a filter designed by me has been in use in Bellary since February, 1896. It received the sewage of a large household continuously for fourteen months, without change of material. During the whole of this period the filter remained practically odourless. On removal, the stone and gravel were found perfectly clean, according to Certificated Sanitary Inspector Fairman, who was in charge of the experiment. The object fulfilled by pumping air into the filtering material is to supply freely the oxygen necessary for the action of the nitrifying microbes. In large public filters the principle of artificially supplying air was, I believe, first suggested by Mr. Lowcock. By adding to this filter a partition for receipt of the filtrate having at the bottom a tube bent so as to act as a syphon, discharge and, consequently, self-aëration, can be effected at regular intervals.

It will be noticed that these arrangements do not get rid of the fact that water is allowed to soak in the ground in the vicinity of dwellings; but whilst this is objectionable, it is better that the fairly pure water represented by the filtrate should be subjected to evaporation and sun action than untreated sewage should saturate the soil.

*Filter Trenches.*—Where a considerable amount of refuse water has to be got rid of in camps, an easy way of arranging for cleanly and prompt disposal is to make “bacterial filter trenches”—18" broad 18" deep, and of such length as may be found necessary, with reference to the quantity of water to be got rid of. The bottom of this trench should be loosened by crowbars; upon the bottom thus prepared should be placed 4" rough stone, or broken metal, followed by 6" of clean gravel, 6" of

sand, and a single layer of rough stone, or metal, to keep the sand *in situ*. Sullage water thrown on, or led by drains to, this filter would become greatly purified during its passage through the filter, and disappear by lateral soakage through the ground. Small filters of this pattern work well when attached to semi-permanent latrines for receipt of urine and washings. After precipitation with lime of the waste water of tanneries in masonry reservoirs, these trenches also serve well for inodorous and cheap disposal of the supernatant fluid.

### \* Notes and Specification for a Caste Plague Hospital.

#### GENERAL.

*Basement Walls.*—These, wherever shown, are not intended to support the superstructure. They are merely for retaining the earth-filling in the basement, and are therefore only 9" in thickness. The basement walls should be built *after* the posts and the framework of the roof have been placed in position.

The basement walls may be constructed of materials described below, the choice depending on the funds available:—

- (1) Brickwork in chunam, plastered over with cement,  
or
- (2) Brickwork in clay, plastered over with cement, or
- (3) Brickwork in chunam, pointed, or
- (4) Brickwork in clay, pointed with chunam. The  
basement walls shall be 9" in thickness raised  
9" above ground and with a foundation of 9"  
below ground.

*Flooring.*—The concrete floor shall be formed of 4" of concrete plastered over with Portland cement. The concrete shall be composed of 4 parts of broken bricks (1" gauge), 2 parts of sand, and 1 part of slaked chunam.

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\* P. C. Proceedings, No. 220-A., 10th December, 1898.

The cement plastering shall be laid in a single coat of  $\frac{1}{2}$  thickness, and shall consist of 1 of cement and 2 of sand. If sufficient funds be available, concrete cement plaster should be employed as shown on the plans; if not, gravel may be substituted, *except in latrines, bath-rooms, disinfecting platform and mortuary*. The gravel floor shall consist of 4" of gravel rammed down to as smooth a surface as possible.

*Posts and Bressummer.*—These may be either of casuarina, or any other approved wood. The posts shall be fixed at least 2' deep in the ground. A greater depth may be allowed if, by nature of the soil, the contractor considers it necessary. The posts shall be well tarred before being fixed in the ground, and the tarring shall be carried to a height of 2' above floor level.

The position of the posts are clearly indicated on the plan.

*Walling.*—The walling as well as doors and windows will consist of double bamboo mats framed with bamboo reepers on bamboo runners, securely fixed to the posts. The walling shall be carried to within  $1\frac{1}{2}$ ' of the bressummers, the space of  $1\frac{1}{2}$ ' at the top being left entirely open.

*Doors and Windows.*—The doors and windows shall all open on the outside. The windows shall be hinged on the top and bamboo struts shall be provided to keep them open. The struts shall be secured to the walling by a sufficiently long rope. The hinges of the doors and windows shall be of strong coir rope. All windows will be  $3' \times 2'$ , the longer dimension being placed horizontally.

The doors of the wards, hospital assistants' quarters, nurses' quarters and the mortuary will be  $3' \times 6\frac{1}{2}'$ . All other doors will be  $3' \times 6'$ .

*Roofing.*—The manner of trussing the various roofs is shown on the plan. But the contractor will be allowed to modify the arrangement with the consent of the supervising officer according to circumstances. The roofing will consist of single bamboo matting and over that paddy straw or hill



grass supported by, and firmly secured to, bamboo rafters and reepers. In thatching the material employed should so overlap and be of a thickness that will render the roof watertight.

The roof shall have a slope of 2 to 1, or in other words, the rise of the roof shall be equal to half the span. The verandah roof shall have the same slope as the main roof.

*Wards.*—The wards are two in number—one for males and one for females. The male ward measures (available space)  $120' \times 16'$ , and the female ward  $96' \times 16'$ . They are intended to accommodate 10 and 8 patients, respectively, with a wall space of  $12'$  and a superficial area of  $12' \times 16' = 192$  square feet for each bed. The number of square feet allowed over the standard of 144 square feet laid down in paragraph 3 of hints is due to the necessity where a single row of beds is used to allow additional space for relatives and nursing staff, &c. The wards have a verandah  $5'$  wide running all along on one side. The communication between the wards and the verandahs will be by as many doors, each  $3' \times 6\frac{1}{2}'$ , as there are beds in the ward. So as to secure the advantages of the protection afforded by the verandah, the beds of the patients should be placed on this side at a distance of  $2'$  from the wall. On the opposite side of the ward, there will be two windows  $3' \times 2'$ , one on each side of the bed. There will thus be two windows between each two beds. The doors and windows are so arranged, because of the necessity that may arise for cutting off any bed or beds from the others. The arrangement of doors and windows shown will allow of this being done without interfering with ventilation or easy ingress and egress. The height of wards from the floor to the bressummer is  $12'$ .

The wards will have a basement wall all round as described in paragraph 1 *supra*. The flooring will consist of concrete plastered over with Portland cement, or if economy is essential, the floor may be formed of gravel as described before. If a concrete floor is laid it should have a fall of

1 in 100 from the verandah side to the opposite to facilitate the cleansing of the floor. Each ward will have a detached latrine and bath-room as shown on plan, and there will be a common cook-room, measuring 20'  $\times$  8' for the patients.

*Hospital Assistant's Quarters.*—This will consist of the following :—

- (1) A drug-room 10'  $\times$  12' with an adjoining verandah 5' wide.
- (2) A living-room 12'  $\times$  12' with an adjoining verandah 5' wide and a bath-room 6'  $\times$  6' attached to the rear side.
- (3) A detached cook-room.

The main block will have a basement wall as described before and a gravelled floor. The height of the rooms will be 12' from the floor to the bressummer. The bath and cook-rooms will be as specified elsewhere.

*Nurses' Quarters.*—These will consist of two adjoining rooms, each 12'  $\times$  12' and 12' high with a bath-room 6'  $\times$  6' attached to each. The rooms will have a gravelled floor with a basement wall around; pertaining to these quarters there will be a common cook-room 12'  $\times$  6'.

*Quarters for Relatives of Patients.*—These will consist of two blocks, each containing six rooms 10'  $\times$  10' and 11' high with a verandah 5' wide on one side. The floor will be of gravel made into a ramp 6" high without any basement wall. There will be a bath-room and latrine, one each for males and females, and a common cook-room for the use of all the inmates.

*Servants' Quarters and Sweepers' Quarters.*—These will consist of three blocks as shown on the plan. The blocks for servants and orderlies will have three rooms each 10'  $\times$  10' and 8' high. The block for sweepers will contain four rooms each 10'  $\times$  8' and 7' high. The floor will be of gravel made into a ramp 6" above ground without any basement

wall. A latrine will be provided as shown on plan for the use of these people.

*Mortuary.*—This will be in two compartments each 10' × 10' and 10' high, one for male corpses and the other for female corpses. The building will have a basement wall with concrete floor plastered over with cement. The floor will have slope of 1 in 100 towards the side on which the cesspool is situated. Along the edge of the floor there will be a low wall 3" high and one brick thick. The walling will be of corrugated iron sheets to a height of about 2' from floor and above this the usual bamboo matting.

*The Disinfecting Platform.*—This will be an open platform (without any tatty walling or roof) 12' × 10' with floor formed exactly the same as that for the mortuary.

*Cook-rooms.*—These will be of the dimensions given below :—

For patients ... 20' × 8' with ten fire places.

For relatives of patients 15' × 6' with seven fire places.

For Hospital Assistant. 10' × 6' with two fire places.

For nurses ... 12' × 6' with three fire places.

All these rooms will be 8' high and have a plain gravelled floor without a basement wall. The fire places will be formed in the usual manner in this part of the country with earthenware *addupoos* bedded in clay and placed 2' from centre to centre. As a protection to the tatty walling from fire there will be a brick in clay wall 2' high between the fire place and the tatties as shown on the plan.

There will be a small sink in each of the cook-rooms connected with a cesspool outside. The sinks will be formed of 4" concrete with a curb wall 4½" wide and 3" high, the whole plastered over with cement.

*Bath-rooms.*—All bath-rooms, whether attached or detached from the main blocks, will be 6' square and 7' high from the floor to the bressummer. They will have a basement wall with concrete floor plastered over with Portland



cement. Along the edge of the floor there will be a low wall 3" high and one brick thick. The floor will slope in the direction of the cesspool. The bath-rooms will have tatty walling.

*Latrines.*—The privy receptacles will consist of a 9" semi-oval channel formed of concrete *in situ* between two parallel masonry walls. The channel will be partitioned into spaces 2½' wide. In each space there will be placed a galvanized iron or stoneware pan across the channel with the edges of the pan resting on the walls of the channel. These pans will be shallower than the channel itself so as to allow a clear passage between the two. The walls of the channel will serve as foot rests. The solid excrement will be received in the pans and the urine will be discharged into the open channel. The channel shall have a fall in the direction of the cesspool of not less than ¼" per every foot of its length. The building will have tatty walling and a roof as in other structures. The whole of the exposed masonry, including the channel, shall be plastered in cement as already specified.

*Cesspools.*—The cesspools shall measure 1½' × 1½' × 1½' inside. The floor shall be of 4" concrete, the walls of 9" thick brickwork and the whole of the interior and the top of the walls shall be plastered with cement.

# Abstract of Detailed Estimate for the Construction of a Plague Hospital.

BLOCK No. 1, MALE WARD FOR 10 BEDS.

Quantity.	Description of Work.	Rate.			Per	Amount.			Total.
		RS.	A.	P.		RS.	A.	P.	
744 c. ft.	Earthwork								
1,170 "	Concrete in chunam								
317 "	Brickwork in clay								
27.6 sqrs.	Plastering with cement, $\frac{1}{2}$ " thick								
1,743 r. ft.	Casuarina wood								
40½ sqrs.	Thatched roofing with bamboo rafters and reepers and mats, &c., complete								
30.32 "	Bamboo matting including bamboo runners and reepers, doors and windows								
1 no.	Cesspool								
...	Contingencies								
	Total								







# Abstract of Detailed Estimate for the Construction of a Plague Hospital—(Continued).

## BLOCK No. 3, QUARTERS FOR NURSES.

Quantity.	Description of Work.	Rate.			Per	Amount.			Total.
		RS.	A.	P.		RS.	A.	P.	
242 c. ft.	Earthwork	...	...	...					
14 "	Concrete in chunam	...	...	...					
130 "	Gravel filling	...	...	...					
128 "	Brick in clay	...	...	...					
2·075 sqrs.	Plastering with cement, ½" thick	...	...	...					
442 r. ft.	Casuarina wood	...	...	...					
9 sqrs.	Thatched roofing with bamboo rafters and reepers and mats, &c., complete	...	...	...					
12·66 "	Bamboo matting with bamboo runners and reepers including doors, &c.	...	...	...					
2 nos.	Cesspools	...	...	...					
...	Contingencies	...	...	...					
	Total	...	...	...					
	Carried over	...	...	...					

## A few Notes on Ancient Hindu and Mahomedan Sanitary Methods.

It is a trite fact that religion and sanitation were, in olden days, closely associated. The priests formed the sole repositories of all knowledge, and it was hence necessarily they who could best interpret disease causation and its prevention. Thus it is we find the old Testament teeming with precise sanitary directions, that many such exist in the Koran and in the "traditions" of the Mahomedan, and that in ancient India the system of sanitation was so woven upon the religious and daily lives of the people that classes became distinguished from one another by the nature of their sanitary observances, and that, in combination with rulings astutely destined to consolidate the authority of the priesthood, the mighty system of caste was evolved.

In perfecting such a method of sanitary government, necessarily, rulings were more addressed to the individual than to the community; the interests of the latter were sought to be served indirectly by restraint of the unit. Hence, it is but here and there that allusion is made in ancient Hindu writings to Municipal methods; they nevertheless exist. In our modern works on sanitation, it is found necessary to expound a reason for everything that is recommended; with the consequence that to secure a ruling as to what should and should not be done much matter has to be waded through. With the writers of Hindu Shastras, however, wordy explanations were not necessary. They adopted simple and correct principles as to purity, impurity, and purification, that embraced the whole science of sanitation. Armed with the knowledge of hygiene possessed by us about fifty years back, I do not know that such a classification would have appeared either reasonable or suitable to a Western people, except that it had the merit of simplicity, and could therefore be "understood of the people." But, in these days of bacteriology, I can imagine no more suitable classification for a modern



treatise than that indicated ; purity and impurity would be explained in relation to pathogenic microbes, and purification to processes of sterilization or disinfection. In short, there would be evolved rulings for keeping pure that which is pure, recognizing that which is impure, and securing the purification of the impure. In reference to the methods of purification adopted by ancient Hindus, it is well to remember that the system was not meant for rich Municipalities that could spend at the rate of lakhs per month for substances evolved by curious machinery from the midst of coal, but for individuals who were scattered throughout the land, living simply agricultural or pastoral lives of much simplicity, and by no means grouped in well-populated centres as in the present day. The methods advised are, therefore; with few exceptions, such as are available in every-day life, instead of depending upon artificial aids they utilize to the utmost laws affecting change by chemical combination, and microbial action, as found in Nature.

In illustration of these principles, let Hindu rulings be considered in reference to the protection of the alimentary canal. Irrespective of the well-known standard demand that the whole body shall be bathed, and that clean clothing shall be worn during meal times, which implies protection from microbes that incidentally to the avocations of the day have adhered to the body and clothing, there is a ruling which is aimed against the lodgment of parasites, or their eggs, under the nails of the hands with which food is eaten : "let him not crush earth or clods, nor tear off grass with his nails," "a man who crushes clods, tears off grass, or bites his nails, goes to perdition." It will be noted that although the punishment is deferred, it is of a summary nature.

Having regard to the special mode of ablution in this country, the possibility of self-infection by the eggs of intestinal parasites is evident, if the practice of nail-biting

were permitted, whilst the forbidding of the breaking of clods and of grass with the nails seems directed specially against the propagation of the intestinal worm known as the anchylostomum. This parasite is excessively common throughout India. Recent investigations by Captain Williams, I.M.S., tend to show that a large proportion, possibly over 50 per cent., of the native inhabitants of Madras are affected with it, whilst, in other areas, it has been found as high as 75 per cent. This parasite acts literally as a leech, by sucking the blood of its host, after attaching itself to the intestines. The result is general weakness, and the train of affections following bloodlessness of the parasites happen to be numerous. After the eggs have passed from the human intestines, the future parasite exists in a larvel state in the earth; hence, the forbidding of biting the nails, or of breaking clods of earth, is of immense sanitary value when dealing with an agricultural population. As to care in the selection of food, we have the duty of the modern medical officer of health depicted in the requirement that no food shall be eaten "which is declared bad by a learned man;" adulterations are also directly inveighed against. It is now well known that food which has been exposed to air, in a cold state, may have sown upon it the microbes of cholera, typhoid fever, and, probably, plague, by means of flies and ants that have been in contact with infective matter, or imperfectly dried dust containing these microbes possessed of sufficient vitality to recover vigour in the presence of moisture, may settle upon it. Hence, the householder is directed, when giving food, to see that it is "*very hot*"—a condition that would effectually kill microbes. By way of aiding digestion, the requirement is added to this ruling that guests are to eat in silence—a familiar dictate of the European nursery. Protection from microbes and intestinal derangements also underlies the ruling that there shall not be eaten "any sweet thing that has turned sour, nor what has been kept a whole night, nor the leavings of

another man." It is obvious that the beaks as well as the feet of birds that haunt dwellings, or the feet of man, may have been thrust into foul matter bearing disease germs; their subsequent contact with food would therefore be dangerous. Hence, the prohibition to use food contaminated by the touch of the human foot, or by the beak, or feet, of birds.

The necessity for the careful collection of water and its subsequent sanitary protection is fully recognized. Pure water is held to be known by qualities such as are taught to modern sanitary students under "the physical properties of water," namely that "water possessing the proper smell, colour, and taste, and unmixed with impure substances, is pure, *if it is collected on pure grounds*. You will note the appropriateness from a sanitary point of view of this last clause. It points in no undecided manner to the necessity for the whole catchment area of a surface water supply being in a sanitarily pure state. This would necessarily forbid the use of catchments inhabited by human beings. The ignoring of this precaution costs towns and villages in this country dearly in the form of human life, sacrificed to cholera, dysentery, diarrhœa, and, in certain instances, typhoid fever. So fully is this fact recognized by modern sanitarians that Municipal bodies in Europe now spend sums that are calculable in millions of pounds, with the object of securing that, in the words of the shastras, the water shall "be collected on pure ground." Having secured pure water, it is obvious that the next thing to be taught is how to preserve its purity. Here, the caste custom of preventing the lower and less educated castes touching water or vessels to be used by the higher, must undoubtedly form a considerable protection against the accidental introduction of microbes or parasites. But, where public water-supplies are concerned, it is evident that something approaching Municipal law is necessary. Hence, the answering of the calls of nature on the banks of a river, or in water, is absolutely



forbidden. In consequence of this ruling, where there is reason for proximity to a river, a careful Hindu will form a special depression at a distance from the water, that should prevent surface washings carrying the impurity to it on the occurrence of rains. Possibly, as further impressing this care, the banks of rivers are regarded as "pure" places, where offerings may suitably be made to the spirits of the departed. Nothing could be more comprehensive than the following ruling for the sanitary protection of water: "let him not throw urine or fæces into the water, nor saliva, nor clothes defiled by impure substances, nor any other impurity, nor blood, nor poisonous things."

I need hardly say that the matter-of-fact inspecting officer of the present day finds Hindus ignoring these dictates in the most repugnant manner, and that to their sanitary sin in this respect is due a very large proportion of the bodily suffering, death, and consequent want of material prosperity of our populations. But, with our best endeavours, impure water may have to be dealt with. Hence, the methods of purification find a place in the Shastras. In the case of a river, it is held that it is "purified by its currents." This statement is absolutely in accord with modern sanitary and bacteriological research, but is sadly misapplied by the present day Hindu, and is consequently productive of an immensity of harm. One would think there could be no difference of opinion as to the limit of the sanitary truth alluded to—yet there is not one per cent. of the less educated class of Hindus that will not quote it as a reason for defiling running water in the most gross manner. In common parlance, the phrase has been corrupted into "running water is pure." Consequently, the most scrupulous Brahman does not hesitate to take water in the full knowledge that immediately above the site selected by him for withdrawal, the town dhobies are sending him the accumulated filth from the bodies of all classes and castes. That water is purified by its current is true; but the Brahmin who commits the sin of using daily defiled water

should remember that twenty, thirty and more miles flow is really necessary for water to be purified, and that the Shastras do not state that water is pure simply because it is "running." As an instance in point, I may state that the sacred river Caveri is certainly capable of taking cholera microbes (which are derived, be it remembered, from the vomit and excreta of man without respect to caste) 18 miles before purification occurs.

So far the rulings quoted by me have been derived either from the Institutes of Vishnu or the laws of Manu, and I would take this opportunity of stating that being myself versed neither in Sanskrit nor Arabic, such quotations as follow, that are not available in English, have been gathered for me from time to time by the courtesy of many native friends. The Ashtanga Haridaya points out that the purest water is that derived by nature's distillation, namely rain water, and that it should be collected on material that cannot give up to it any impurity. The preference is given to vessels of silver and gold, but, failing it being possible to obtain rain-water with this care, it is held that clean hard ground is the next best place in which to collect it. The precaution is added, in this event, that the water and the ground must be freely exposed to sun and wind. Special warning is given not to drink water that is defiled by mud, moths (the latter would probably cover mosquitoes and is therefore of importance in respect to elephantiasis and malarial fever,) dirt, or leaves, and that which is not exposed to the "sun, moon and wind." It is also held that surface water recently collected, as shown by its having foam, should not be used, but, if necessity compels, it should at least stand exposed to the sun and wind for three days. This ruling is of great sanitary importance, in that it has been clearly proved that the first flood of a river is likely to convey with it much organic matter, and, if within an inhabited area, an abundance of microbes. When such water can be dispensed with on modern and public water-works it is rigidly excluded. But, I would particularly call attention

to the fact that the directions as to exposure to sun and wind are not with reference to well water, but to rain water collected from exposed surfaces; that is, river or tank water. This is another important ruling that has been perversely interpreted by the modern Hindu. He holds that *all* water must be exposed to the sun, and, consequently, demands that no covers be placed on wells, with the result that their contamination is favoured. Now, if the actual circumstance of the ruling be held in mind, it will be found that again modern sanitary and bacteriological research fully confirms its wisdom. It has been recently shown that rest of surface water in reservoirs secures vast improvement in organic and bacterial impurities. The reason is that not only sedimentation is favoured, but, in the presence of oxygen, nitrification by microbes that have been washed with organic matter from the surface of land proceeds apace: whilst sunlight acting to a limited depth deals death to them when their task is completed. But, in the case of well water, the conditions are different. It is found that exposure causes degeneration of the water. In this case, the water collected from a pure subsoil should be free, or almost free, of microbes and of organic matter still requiring change; hence, to expose it is merely to run the risk of both introduction of microbes and defiling matter. The typically pure method of getting subsoil water—which as stored by Nature is innocent of sunlight—is by means of a Norton's tube well, which permits direct withdrawal *in the dark* from the water-bearing layer. A further well recognized mode of purification of water is also distinctly conceded, one which it so happens American authors of the present day lay special stress on, in regard to public water-supplies, namely, the oxygenation of water by scattering it so that it comes in free contact with air. It is held in the Astanga Hridaya that the rivers flowing from the Himalayas owe their purity to this fact, their waters having been scattered and dashed from stone to stone at their source. Whilst the efficacy of rest for surface water



is pointed out, the accession of increments to mere remnants stored in tanks from former seasons is directly inveighed against by Charaka: that is, he warns against the use, for human beings, of tanks of such small capacity that, for some time between the monsoons, mere shallow pools are left. There can be no doubt of the wisdom of this advice; for, irrespective of increased chances of contamination, certain algae and vile odour-producing microbes would be favoured in growth in such stagnant pools and would ultimately infect, and multiply in, fresh water brought with the next monsoon.

For the artificial purification of water not only is the "clearing nut" (*Strychnos potatorum*) alluded to, but straining by cloth to stay suspended matter, with subsequent exposure to sun, and, finally, the dropping of red hot balls into the water. It will be understood, therefore, that the importance of killing living pathogenic microbes by means of boiling was recognized in very ancient times. Boiled water was also recommended in various disorders of the system, particularly fever. I have been informed that in the mountains near Palghat, which are highly malarious, the hill-men preserve themselves from malaria by careful choice of water, and strict adherence to the selected source to the exclusion of all others, combined with boiling; showing that this sanitary precaution has descended to them, and that experience has dictated the necessity for its continuance. In Savanshadi Guna Kalpakam, it is pointed out that water which has been boiled and then cooled is of much advantage in certain diseased conditions; but it warns that such water should not be kept over nights, as degeneration of its condition ensues—a warning that covers the possible introduction of microbes after the water has been cooled—a fact that in modern life is very often forgotten in household sanitation.

There is probably no more important branch of practical sanitation than that of correct night-soil conservancy, by

which man is protected against his own excretions: for both to the humble microbe and to man their respective excretions bring death. In no more frequent way are disease-bearing microbes and parasites aided on their path of mischief than by neglect of night-soil conservancy. It is the foundation—the A, B, C—of Municipal sanitation which, I am sorry to say, is constantly ignored by your modern Municipalities, that nevertheless find time to debate gravely as to the details of water-supply and drainage systems costing many lakhs. Places where it is proper and improper to answer the calls of nature are definitely stated. Certain of these places in relation to water-supply have been already mentioned; but it may be of use for me to add that the King's highway is specifically held by Manu to be an unfit place. The punishment amongst others laid down for a breach in this latter rule is of a very suitable and just type, the person committing the error being required to cleanse the defiled place. It is a pity this effective law does not still possess force. Both Municipal conservancy and sewerage are foreshadowed in the following ruling by Manu:—"Far from his dwelling let him remove urine and ordure, far let him remove the water used for washing his feet and the water from his bath." A further Municipal ruling of great value which, I am sorry to say, is greatly neglected throughout this Presidency, is the insisting upon a reserve of land for public purposes in the outskirts of villages: "On all sides of a village a space one hundred *dhanus* shall be reserved for pasture, and thrice that space round the town." The exigencies of modern existence may not permit this liberality in full, but neither need the greed of landowners of the present day be so excessive that irrigation is carried up to the door of the agriculturist's hut.

I have already held that the system of sanitation of the Hindus recognized the microbial theory of disease, or, put in other words, the presence of a transmissible living contagium. In no other way does it seem possible to explain the following various precautions laid down as to

the preservation of purity :—The Hindu “ must not bathe in tanks belonging to other men”—a precaution which seems neglected in parts of this Presidency other than Malabar; he must not dwell “ in a village where the sacred law is not obeyed”—in other words in a village where sanitation is imperfect, “ nor long where diseases are epidemic.” For prevention of infection, the precautions not to use “ shoes, garments, a sacred string, ornaments, a garland, or a water vessel used by others,” not to stay “ in a village where a corpse lies, or in the presence of a man who lives like a Sudra”—in other words, lives, insanitarily, according to the Brahmin standard—or “ linger in a crowd of men,” are obviously necessary. In regulating the admissions to “ Sraddhas,” diseased persons, or those undergoing segregation on account of impurity, are excluded. Indeed, if the translation be correct, it would seem that persons suffering from “ consumption” are to be excluded—an advance on the sanitary science of the day that our American cousins have seriously agitated for. An excellent precaution is also laid down in regard to reading the Vedas. It is held that their study must not be pursued in a village where a foul smell arises. If strictly observed, this should lead to the cleansing of a good many places in the Presidency, including this city in certain areas. We know that anthrax, tuberculosis, plague and tetanus are microbic diseases conveyable by inoculation; hence the order, “ not to step on things used for cleaning the body, on water used for a bath, or urine, or ordure, or blood, or mucus, and on anything spat out and vomited,” is one that is well worth while, in the present day, to hold in mind. Attention is called to the danger of transmission of disease in the following order :—A washerman “ shall not return the clothes of one man for those of another, nor allow anybody but the owner to wear them.” There had evidently been “ dhobie questions ” in ancient India, when housewives had reason to complain of their lord’s clothing being pounded into holes on stones: for it was also directed that the



dhobie should "wash the clothes of his employer *gently* on a smooth board of Salmaliwood." The necessity for segregation during the incubation of disease was fully recognized. Thus detailed directions are given as to clothing, food, and exclusion from intercourse not only of those in direct contact with the source of impurity, or, as the modern sanitarian would put it, of infection, but of all those who may be reasonably suspected to have been in contact with persons under the ban of suspicion. Indeed, segregation of groups is so strict, that individuals are enjoined to have some distance between them when sleeping. But where I look for my proof is not so much in rules of what should be done as to those which detail what need not be done. Were it not that actual contact with infectious substances, for example, such as conveyed by corpses, was dreaded, and were the elaborate bathing, and washing, and segregation that must follow, mere ceremonial details, there could reasonably be no distinction as to their perfection or duration, whether the death of a relation occurred by disease or violence, or whether one month or one year elapsed, or whether the event had occurred in the locality where the family is resident, or in a country which is distant. Yet, the Laws of Manu and the Edicts of Vishnu clearly show that a consideration of all these details strictly determines the duration and nature of the period of segregation. More than this, where there might be room for doubt as to the nature of death, and consequent possible room for incubation, the ten days' period is shortened, but still is not dispensed with; precisely as the modern sanitarian would prescribe in the case of persons "under observation" from an infected locality, for example:—

"He who may hear that (a relative) residing in a distant country has died, before ten (days after his death have elapsed) shall be impure for the remainder of the period of ten (days and) nights only."

Here the segregation is presumably required in view of the probable arrival of a messenger with news of the

death, as must have been the case when the Postal Department was hardly so complete as at present, but if ten days had elapsed, this messenger was not to be dreaded; therefore, the following regulations became feasible :—

“ If the ten days have passed, he shall be impure during three (days and) nights; but if a year has elapsed (since the occurrence of the death), he becomes pure merely by bathing.”

But when death had undoubtedly not been due to infection, for example, in battle, or by suicide, no impurity was contracted by the household.

As to the attainment of “purity”—or an approach to sterilization or disinfection—I have already said that the powers of Nature are chiefly relied upon. How well such natural methods of purification have been recognized by ancient Hindus must already be apparent to you from the fact that, in the purification of water, sedimentation, oxygenation by agitation, current flow (implying nitrification and other changes incident to it) direct oxygenation by wind, and the action of sunlight are relied upon: all matters that are seriously discussed in modern sanitary works. Earth, air, fire and water were held by the ancient Hindus to be the great purifiers, and, if the work of purification be traced, it will be seen that each of these is assigned its most appropriate place. It is noteworthy, in the present day, when the sanitary propriety of kissing is gravely discussed that the ancient Hindu held that “the mouth of a woman is always pure.” They were sufficiently gallant in this wise discretion, moreover, to make no limitations as to whether the woman meant was old or young, pretty, or ugly. In reference to conservancy, the deodorizing influence of earth is recognized in the injunction to cover the earth with clods before easement: “by earth and water is purified what ought to be purified \* \* \* a house by sweeping and smearing it with cowdung or whitewash, an earthen

vessel by a second burning.” Metal vessels are to be purified with acids or by heat. As further important purifiers at disposal, the sun and time are distinctly laid down. Those who know the tenets of modern sanitation will appreciate how much in this simple category is really implied. Indeed, in existing plague disinfection arrangements sanctioned by Government, fire, sun, wind and time are largely relied upon. As to sanitary methods applied for staying epidemic diseases, none are more striking than that mentioned (according to the author of *Ayurveda Vijnana*) by Dhanwantari, with reference to prophylactic operation of vaccination. Here it would seem that Jenner’s discovery, though absolutely genuine on his part, was forestalled by ancient Hindus, and the fact that vaccine is but the small-pox virus modified by passing through the sacred bovine is set forth. I need hardly add that a people who discovered vaccination ought not to hesitate in accepting the modern prophylactic operation of anti-plague inoculation. In reference to plague, the disease, of which we now unfortunately are obliged to hear so much of, the only fully effective sanitary precaution yet discovered, namely, the instant evacuation of houses the moment indigenous plague declares itself, is expressly stated in a manthra, which is now in large circulation since my calling public attention to it in March 1898. For the first notice of this important ruling, I was indebted to Mr. Hanumantha Gowd, of Hospet. This runs as follows :—

The goddess said :—

“On the order of Brahma, myself, Indra and other gods will visit the people of various villages. Thus visiting village after village, and putting to death all the wicked people, will at last go to Brahma. Intelligent people understanding my approach will always do virtuous actions, will study the sastras, and will ever be very careful. On the moment the rats fall from the roof above, jump about, and die, they will at once leave their houses with their



friends and relations, and will go to a plain (Vana). There they will do all rites, will utter Mahamarika mantrams and will recite stotrams.

\* \* \* \* \*

“In the forest where there is water convenience they will sit. \* \* \* \* They will have the image of the Deity before them, will show Dupam and Dipam, and will perform Puja every day systematically according to the shastras. Homam will be performed on fire with cooked rice mixed with saffron powder ghee, and sacred twigs in the midst of Brahmins, relations, friends and servants.

\* \* \* \* \*

“After praying to the goddess with great faith in the above manner, they will sit for meals with their relations, always thinking of the Deity. After some days if crows come and sit on their temporary dwellings, they will start to their original home after performing Kaka Santhi (a ceremony to the crows). They themselves, well adorned, will start with their family and innumerable Brahmins on an auspicious day and in an auspicious hour. In their homes, Brahmins will be requested to recite Vedas and to perform Santhi homam.”

\* \* \* \* \*

The recognitions of the dying of rats, as a sign of danger of infection, disposes of any possibility of the disease referred to being other than plague. The term ‘Mahamari’ is used to this day in designating the disease in Gharwal where, as you are doubtless aware, plague has from time immemorial been endemic. This injunction to evacuate the ordinary houses of residence, so completely as to involve removal of ‘relations, friends, and servants’ and to resort to clean ground that has never been lived upon by human beings, and not to return to the infected house till lapse of time and special processes for its purifications have rendered it safe, represent literally the whole

policy of the various regulations issued by each Local Government, in reference to plague-infected villages. Even the modern modes of disinfection in this disease are strictly in accord with those laid down in the shastras for inanimate objects, namely, for the flooring of houses, 'scraping and burning,' for disinfection of buildings, free exposure to sun and wind, and for other objects dry heat or 'hot water,' and chemicals which are 'alkalies and acids.'

Indeed, an admirable summary of the sanitary requirements of plague is stated in the Dharma Sindhu, which, although perhaps a comparatively modern book, could not have been influenced by present day events: 'the plague will subside by deserting the habitation, by prayer, and by burning.'

I have said that, in failing to carry out the dictates of their own Shastras in many sanitary details, Hindus of to-day are bringing upon themselves much suffering and death. In no way can this be more strikingly illustrated than in the ruin of village after village, where this simple dictate of the experience of their forefathers has been neglected, in spite of advice offered them by Government officers. The epidemic of plague is already old enough in this Presidency to point to the admirable results of prompt evacuation of houses in favour of residence in cleanly places in the jungle, as required by the Shastras under reference, and to furnish equally striking instances of disaster to trade and life, when this effective, yet simple precaution, has been neglected.

But, even if there were aught that modern science demanded should be effected in the presence of this public danger, beyond what is thus explicitly sanctioned by rules acknowledged by every good Hindu, I am convinced there is nothing that would justify its obstruction in the name of caste. The Laws of Manu are not those of the Medes and Persians. The possibility of there being times when it would be desirable, in the interest of the individual or of the public, to relax rulings is distinctly provided for.

Whilst malevolent criticism is forbidden, friendly interpretation of the tenets of the shastras by "reasoning and inference" is sanctioned; *even the possibility of change of these is acknowledged as a result of "custom" differing with the times, as followed by "good and virtuous men."* Liberality of thought and action are distinctly encouraged, in the following exhortations to abide by the spirit and not by the letter of the teaching. The Edicts of Vishnu remind the householder that, " (He must avoid) even lawful acts which may give offence to mankind." "A wise man should constantly discharge the paramount duties (called yama) but not always the minor ones" (called niyama). Further, the Laws of Manu require the ascetic to remember that, "Though the fruit of the Kataka tree (the clearing nut) makes the water clear, yet the latter does not become limpid in consequence of the mention of the fruit's name." Above all, provision is made for special dispensation in times of public distress, in the following forcible language. Vishnu states :—

"Nor can impurity arise during the installation of the monument of a Deity, nor during a marriage ceremony, if those ceremonies have actually begun; *nor when the whole country is afflicted with a calamity; nor in times of great public distress* (such as an epidemic or a famine).

Manu states :—

"He who, when in danger of losing his life accepts food from any person whatsoever, is no more tainted by sin, than the sky by mud."

"Agegarta who suffered hunger, approached in order to slay (his own) son and was not tainted by sin, since he (only) sought a remedy against famishing."

"Vamadeva, who well knew right and wrong, did not sully himself when tormented (by hunger) he desired to eat the flesh of a dog in order to save his life."

"Bharadvaga, a performer of great austerities, accepted



many cows from the carpenter Beibu, when he was starving together with his sons in a lonely forest."

"Visvamitra who well knew what is right or wrong, approached, when he was tormented by hunger, (to eat) the haunch of a dog, receiving it from the hands of a Kandala."

If the diminution of trade inducing poverty of the country, and loss of human life can justify the term "public distress" (and, I may say, I do not see how such a conclusion can be reasonably avoided) it seems to me, in the interests of their countrymen, the "men of light and leading" in this Presidency, should anticipate events and forward thereby a policy of liberal thought and action in support of the common weal, by publicly declaring it to be so, after due consultation of "good and virtuous men." Such a declaration might reasonably be applied only to districts actually affected with plague, and be withdrawn the moment a normal condition of health was attained.

In the case of Mahomedans, it would appear that the type of sanitation evolved has been more in accordance with the requirements of communities than that laid down by the Shastras of the Hindus, where the individual is more closely considered. This would be the necessary sequel of their origin as religious warriors, who, after their conquests had little time, as compared with Hindus, to settle the countries they conquered. Nevertheless, we find in the Koran the recognition of the importance of sanitation in the welfare of individuals. Thus the Koran states, "water was created for the purpose of cleanliness and purification;" "keep your dress clean; shun filth and uncleanness"; God loves those who keep themselves clean"; "if while getting yourself clean you leave any portion dirty, you sin." The requirements to shun the eating of the meat of the unclean animal, which was also commanded the Jews, and to abhor all spirituous liquors and intoxicating substances, are also dictates of personal hygiene of importance. In practical sanitary works, the Mahomedan rulers were not wanting.

Magnificent instances of public water works distributed by pipes under pressure exist in Burhanpur, Ahmednagar, and Aurangabad that were made by Mahomedan rulers. Similar works have also owed their existence to the Moors during their invasion of Spain. I know of no sight that can be more interesting to the sanitarian than these grand old water works still performing their duty after the lapse of nearly 300 years. In spite of the non-existence of iron pipes, water is distributed under pressure without stint for public and private purposes, in ornamental gardens, fountains, cascades, and Turkish baths, and the grinding of grain by water-wheels. The sources of these water-supplies in each case was the best that could be procured for sanitary safety, namely, subsoil water from a pure locality by means of infiltration galleries, showing that the Mahomedans possessed skilled Sanitary Engineers. I am informed that, to this day in Beluchistan, the natives form infiltration galleries at high levels, on the same principles, for irrigating their crops in the valleys. In later years, we find the Mahomedans of Constantinople taking the lead in practising inoculation against small-pox, and it was from following their example that this practice, before the introduction of vaccination, was first followed in England. To Mahomedans also, therefore, it may be said, as in the case of Hindus, that the principle on which anti-plague inoculation is founded had been accepted by their forefathers. In treatment of great epidemics caused by plague also, the Mahomedans have shown themselves cognizant of the correct sanitary methods of dealing with it, namely, by prompt evacuation of houses. As facts such as these have faded from memory, and yet have much importance to the Mahomedans in the present day, I some time back applied to the Principal of the Mahomedan College, Aligarh, for the translation of Arabic works dealing with this important phase of Mahomedan sanitation. A version of the action taken by Umar is open to such as do not read Arabic in the Urdu book "Seratool Farookh;" but it would seem that the author has

fallen into the error of speaking of the epidemic that was dealt with as "Woba" or cholera, whereas the original Arabic works dealing with the subject speak distinctly of the disease as Ta-oon, or plague. But in the book just quoted is given a striking answer made by Umar when, after going towards the plague-infected country subsequent to the death of his General, Abu Obeidah, he had yielded to the persuasion of those who considered he was uselessly risking his life, and returned homewards. Certain objections were then made by those who hold that a Mahomedan must remain and die in his own house, without an effort to save life, in the presence of danger. These reproachfully said to him—"Are you running away from the will of God?" To this his reply was—"with the permission of God, I am running away, in the direction ordered by him"—a reply which clearly pointed to the rational conclusion that, whilst we hold our lives at the will of God, we are not in a position to judge that it is His will that we go in this direction or that; and although no action can be taken without His knowledge, such knowledge of our action does not imply the necessity for us to neglect the use of the sense he has graciously given us for our guidance. It is, however, in the original Arabic that we must look for the most accurate account of what took place in the days of Umar, and I prefer therefore to give you the translation with which I have been favoured by Maulvi Khalid Ahmed, Professor of Arabic, Mahomedan College, Aligarh:—

"In the year 18 R. H., plague ravaged the country from Syria to Bnsra. Abu Obeidah bin Jarrah, who occupies a position of high rank among the companions of the Prophet, and who is included among the people called by the name of "Mahaju," and who was the first to embrace Islam in Mecca, was then the General of the Forces stationed in Syria. The Caliph Omar directed him to remove the forces from the plague-stricken districts. An account of this event is given by Abu Ashaari in the following words:—



“ At the time when ‘ taun amwas ’ (plague) visited Syria, I was with Abu Obeidah bin Jarrah. When Omar was informed of the fearful ravages of the plague, he wrote a letter to Abu Obeidah asking him to remove from Syria in these terms :—“ Peace be on you. My object in writing you this letter is that I have important business with you, and I wish to talk to you about it. I, therefore, most solemnly call upon you to join me without fail as soon as you have read this letter of mine.” Abu Obeidah could guess at once that the Caliph Omar wanted to take him from the infected country. Abu Obeidah, therefore, after praying that the Amir’s sins be forgiven, wrote to Omar in reply to say that he could understand the nature of the business Omar wished to consult him on. Abu Obeidah further informed Omar that he was in the Islamic camp, and that he was much attached to the people, and, unless God has decided in favour of him and the Mahomedans stationed in Syria, he had no desire to desert them, and that he hoped Omar would forgive him and let him remain in his camp. Omar wept when he read Abu Obeidah’s letter. All the people present were surprised and asked if Abu Obeidah was dead, but Omar answered in the negative. After this, Omar wrote to Abu Obeidah another letter to the following effect :—“ Peace be on you. I am afraid the people with you are encamped on a low and marshy land. You will be good enough to remove them to a better and elevated place.” Abu Moosa goes on to say that when this last letter reached Abu Obeidah, the latter sent for Abu Moosa and informed him of the contents of Amir’s letter, and asked him to proceed to make arrangements for the encampment of the Faithful, while Abu Obeidah was to follow him (Abu Moosa) along with them. Abu Moosa then returned to his lodgings, and determined on a journey in compliance with Abu Obeidah’s request, but, when he had reached his house, he found his wife had caught the contagious disease. He then went back to Abu Obeidah to say that his wife was unwell, and on being asked by

Abu Obeidah what she was suffering from replied she was laid up with plague. Abu Obeidah then ordered his camel to be saddled, but he had hardly put his foot on the stirrup, when he too was attacked with the disease. Abu Obeidah then wrote to his people to proceed to Jatra, where he had made arrangements for their encampment, *and the plague was thus stamped out.* (Tabri, pp. 2516-2518.) This same event is also described by Ine Jarzi in his work "Taibh i-Kamil," Vol. 2, p. 275.

Although the evidence above-quoted is derived from these two histories, and though historical events very little influence the beliefs of the Mahomedans, still, if it is borne in mind that the learned Tabri is a man of undoubted abilities, and that his opinions and views are admitted on all hands, not only in Hadis (traditions), but also in Tafir (commentary) and in Mahomedan jurisprudence, as well as in all the branches of Islamic learning, and, moreover, if it is remembered that in making the last remark we are amply supported by Ibuc Uhallakan, then this evidence, derived from history as it is, will be regarded of the same force and strength as is necessary in religious matters.

In addition to this, our statement is amply corroborated by Ine Hajr Agalani, in his writings called Fathel Bari in Vol. 10, p. 159, and of all the books on the traditions of the Prophet, just as Bukhari ranks among the highest, even so, no commentary thereon approaches Fathel Bari for its research and depth of meaning.

After stating this exhaustive evidence, there remains another, which clearly proves the necessity of removing from a plague-stricken place. Soon after reaching Jabia, Abu Obeidah died from plague, and Maaz Ibue Jabal was appointed in his place, but he also followed him shortly. Afterwards Amir Ibuel Aas, who was a sound politician and a conqueror of Egypt, was nominated for the high office thus fallen vacant. Omr Ibuel Aas immediately recognized the necessity of changing the place, as it was no longer fit for habitation and ordered his men to remove

to the hills, as the disease was not till then thoroughly stamped out. Although, in so ordering, he incurred the displeasure of some persons, he was firm in his determination, and removed the camp to the hills, and thus got rid of the plague.

The above event is described by Tabri on page 2519.

The third evidence has for its source Abu Moosa Ashaari, who is one of the most celebrated of the Prophets' companions, and who was the Governor of Irak for several generations. After leaving Abu Obeidah in Syria, Abu Moosa Ashaari stayed in Kufa, where some of the people visited him and enquired about the plague in Syria, which is thus described by the historians :—

Tarib Ibne Shahah says :—"We went to Abu Moosa while he was staying in Kufa to see him, with the object of getting some news of Syria from him. When we had all seated ourselves, he said there was no harm in deserting and evacuating the village, where there had been a plague case, and in going to a healthy and better place till the disease had been stamped out. He informed us that he was with Abu Obeidah bin Jarrah when the plague visited Syria (Tabri, p. 2516).

Then Abu Moosa recited all the correspondence that had passed between Abu Obeidah and Caliph Omar for the satisfaction of the people.

The same event is also described by Ibne Asir Jazri in his book "Tarikh-i-Kamil," Vol. VI., p. 275.

The evidence quoted above is reliable and trustworthy for the following several reasons :

(1) that all these incidents were brought into actual practice by the people, and are not mere theories that have nothing to do with their actions ;

(2) that this evidence is not limited to a particular part of the Islamic countries, but relates to the three important places which abounded in the Companions of the Prophet, viz., Syria, Irak,



and Hedjaz. Their origin is from Hedjaz ; they were put in force in Syria, and were acted upon in Irak ; and, lastly, that these circumstances did not involve action by one or two individuals, but were common among all—the ruler as well as the ruled.

Even during the lifetime of the Prophet, we find practical evidence which goes to prove that certain directions were given by the Prophet as to keeping oneself safe from injurious and unhealthy climate. For example, the following is given in Bukhari in these words :—

“Some people of the clans of Akal and Arina went to the Prophet, and embraced Islam. They told the prophet that had no lands to cultivate but they lived on their camel's milk, and that the climate of Medina did not agree with them. The prophet then permitted them to leave Medina and to settle down in the fields. This very fact has also been recorded by Abu Daood. (Bukhari, Vol. 10, p. 159.)

“Similarly, we have specific directions for avoiding the company of lepers, and the following traditions prove our statement :—

- (1) In the caravan of Sagif there was a leper, and the prophet of Arabia sent word to him to say that he might return to his home now that he had embraced Islam.
- (2) “Whenever you come across a leper flee from him as you would from a lion.”
- (3) “Talk to a leper in such a manner that the distance between you and him be no less than the length of two spears.”
- (4) “Do not eye the leper closely.”
- (5) The prophet of God said, ‘do not permit the healthy to go to the sick.’

“These directions, with many more that might be quoted to the same effect, lead us to the conclusion that it is incumbent on all of us Mahomedans to avoid unhealthy places, and to remove to a healthy one.”

To the above evidence, by the learned Mushi of the Aligarh Mahomedan College, may be added the following quotations from a recent pamphlet by Muhamed Zahiruddin Meccai, B.A. :—

“In the holy Koran, the Almighty ordains ‘*Va la Tulku Bi Idi Kum Ilat Tahlu Kati*,’ *i.e.*, ‘throw not your lives in danger.’ It is plain from this verse that God enjoins on all that when in any place there are circumstances endangering life, and those living in such place are dying, then such place should be avoided. \* \* \* \*

“Hazrath Moulana Room says (in his Masuavi),” said the prophet with a loud voice, “secure the camel by means of a rope, and then depend on God for safety.” Similarly, men should try to avoid all causes tending towards any disease, and then depend on Fate. It is clear, therefore, that if we should not devise measures to avoid the disease nor take step to prevent its spread, nor even allow others to do so, but simply leave everything to fate, we should be violating the commands of God and His prophet.

In conclusion, I would remind that, at the outset of this address, I could but promise you a brief catalogue of some of the more prominent methods of sanitation dictated by your forefathers ; but, I think, I have taxed your patience sufficiently long to prove to you that ancient Hindus and Mahomedans grasped the great principles of sanitation which form the foundation upon which the present day science rests, and that, consequently, it is absurd for the mass to regard sanitation as the offspring of a western craving for the introduction of new fads. On the opposite, I have a right to conclude that it is a serious fault with both Mahomedans and Hindus that they should have allowed the theory and practice of sanitation to fall so much into

disuse that, when presented to them in the form of modern legal rulings for the sanitary protection of the people, they fail to recognize that, under a new guise, they are dealing with old friends. It is worth remembering, at this juncture when plague surrounds us that "health is wealth:" or, in other words, that the people who will carry sanitation into their homes and, as good citizens, uphold it in public, must reap "health and wealth," but that the penalty of the neglect of sanitary law is financial ruin and death, as proved by the history of every people that has had the temerity to ignore them.















